F.Y.P.G.D.O.R.M. (Sem-I)

April 2017

Applied Mathematics for Management

Con. 289–17. DT–5575

(3 Hours) [Total Marks : 80

N.B. : (1) Q. 1 is **compulsory**.
(2) Attempt any **three** questions from Q. 2 to Q. 5.
(3) Scientific **non-programmable** handheld **calculator** is allowed.

1. Rewrite the following statements with correct option. (any **ten**) **20**

(i) If the interest is compounded annually at 8%, the present value of Rs. 6000 payable 2 years hence is
(a) 5144.03 (b) 5044 (c) 5404.5 (d) 5000

(ii) $\lim_{x\to 3}\frac{x^3-27}{x-3}$ is equal to
(a) 25 (b) 27 (c) 20 (d) 10

(iii) $\frac{x}{4}=\frac{y}{3}=\frac{z}{2}$ *and* $7x+8y+5z=62$ Solve for x and y and z.
(a) (4,3,2) (b) (2,3,4) (c) (3,4,2) (d) (4,2,3)

(iv) If f (x) = x^2 then $\lim_{h\to 0}\frac{f(2+h)-f(2)}{h}$ is equal to
(a) 25 (b) 12 (c) 29 (d) 4

(v) If the average revenue is 45 and the elasticity of demand is 5 than the marginal revenue is
(a) 24 (b) 36 (c) 20 (d) 30

(vi) The matrix $\begin{bmatrix}1&0&0\\0&2&0\\0&0&3\end{bmatrix}_{3x3}$ is a _____.
(a) Scalar matrix (b) Identity matrix (c) Null matrix (d) None of these

(vii) If the roots of eq^n $x^2 + (2p - 1)x + p^2 = 0$ are real, then
(a) $p \geq 1$ (b) $p \leq 4$ (c) $p \geq ¼$ (d) $p \leq ¼$

(viii) If $f'(x)=\frac{x^2}{2}-ax+1$, f (0) = 2 than integration constant is _____.
(a) 3 (b) –3 (c) 4 (d) 2

(ix) Find $\frac{d^2y}{dx^2}$, *if* $y=2x^3+3x^2+20$
(a) 12x – 6 (b) 12x + 6 (c) 6x + 6 (d) 6x – 6

[TURN OVER

(x) If marginal revenue is MR = $7-4x-x^2$, the revenue function is

(a) $7x-2x^2-\frac{x^3}{3}+c$ (b) $-4-2x$ (c) $7x-4x^2-\frac{x^3}{3}$ (d) $7-4x-x^2$

(xi) Simple interest on Rs. 16,000 for 3 years at 10% p.a. is

(a) 4800 (b) 480 (c) 48 (d) 48000

(xii) If $A=\begin{bmatrix}2 & -1\\ 0 & 3\end{bmatrix}$ and B = $\begin{bmatrix}7 & 0\\ -2 & -3\end{bmatrix}$ two matrices then AB is

(a) $\begin{bmatrix}16 & 3\\ -6 & -9\end{bmatrix}$ (b) $\begin{bmatrix}10 & -10\\ -7 & 8\end{bmatrix}$ (c) $\begin{bmatrix}12 & -4\\ 4 & 6\end{bmatrix}$ (d) $\begin{bmatrix}15 & -3\\ 5 & 9\end{bmatrix}$

2. (a) If α, β be the roots of $2x^2 - 4x - 1 = 0$ the value of $\frac{\alpha^2}{\beta}+\frac{\beta^2}{\alpha}$. **20**

(b) The demand and supply equations for a certain commodity are $4q + 7p = 17$ and $p=\frac{q}{3}+\frac{7}{4}$ respectively where p market price ; q : quantity. Find the equilibrium price and qunatity.

(c) Find the adjoint of the matrix A where $A=\begin{bmatrix}1 & 3 & 3\\ 1 & 4 & 3\\ 1 & 3 & 4\end{bmatrix}$.

(d) Solve Simultaneous Linear Equations determinant by using Cramer's rule :
$3x + 2y = 5$, $4x + y = 3$

3. (a) A TV is purchased for Rs. 5,000 cash down and Rs. 10,000 at end of each month, for 4 months. Find the cash price of the TV if the payments include interest payment at 12% p.a. compounded monthly. **20**

(b) A principal amounts to Rs. 9,680 after 3 years and to Rs. 10,800 after 5 years. Find the principal and rate of interest.

(c) Consider

$$\begin{aligned} f(x) &= x+1 && -1 < x < 0\\ &= 1 && 0 \le x < 1\\ &= x && 1 \le x < 2 \end{aligned}$$

Examine whether f (x) is continuous at x = 1.

(d) Evaluate $\lim_{n\to\infty} \frac{2n^3+5n^2-n}{4n^3-1}$

4. (a) Verify Euler's theorem for the function $z=\frac{x^{1/4}+y^{1/4}}{x^{1/5}+y^{1/5}}$. **20**

(b) Find the points of maximum & minimums for the function $z = x^3 + 3xy^2 - 3x^2 - 3y^2 + 4$

(c) For the certain product total cost $C = x^3 - 9x^2 + 24x + 17$ and total Revenue $R = 5x^3 - 45x^2 + 120x + 30$ is find x for which the profit is maximum.

(d) Find $\frac{dy}{dx}$: (i) $y = x^7\ 7^x + e^x \log x$ (ii) $y = \frac{5e^x + \log_e x}{x^2}$

5. (a) Evaluate $\int \frac{(3x+2)}{(x-2)^2(x-3)}\,dx$ **20**

(b) The marginal cost of a production of a firm is given as C' (x) = 5 + 0.13x. Further, the marginal revenue is R' (x) = 18, Also it is given that C (0) = Rs. 120. Compute the total profit.

(c) Find the producer surplus defined by demand curve D (x) = 20–5x and supply curve S (x) = 4x + 8.

(d) Evlauate $\int_1^2 x \log x dx$.

F.Y.P.G.D.O.R.M. (Sem-I) April 2017

11 : 1st Half-2017-(c)-Avi

Con. 291-17. Basic Statistics For Management **DT-5166**

(3 Hours) **[Total Marks : 80**

N.B. (1) **All** questions carry **20** marks.
(2) Question No. **1** is **compulsory** and attempt **three** questions out of Question Nos. **2** to **5.**
(3) Scientific **non-programmable** handheld calculator is **allowed.**
(4) Graph paper will be **provided** on **request.**

1. (a) Multiple choice questions :— **10**

(1) If the value of arithmetic mean and median are 34.5 and 34.1 respectively, the value of mode can be :
(a) 33.3 (c) 40.2
(b) 35.7 (d) None of them

(2) Quartile deviation calculate the deviation of :
(a) First 50% of data (c) Middle 50% of data
(b) Last 50% of data (d) All the data

(3) If $A \cup B = \phi$ then A and B are said to be :
(a) exhaustive (c) both A and B
(b) exclusive (d) none

(4) Relationship between ${}^{n}p_{r}$ rand ${}^{n}c_{r}$ is :
(a) ${}^{n}p_{r} = {}^{n}c_{r} + r!$ (c) ${}^{n}p_{r} = {}^{n}c_{r} - r!$
(b) ${}^{n}p_{r} = {}^{n}c_{r} \times r!$ (d) ${}^{n}p_{r} = {}^{n}c_{r} / r!$

(5) For a Binomial distribution, mean is 10 and n = 30 then the probability of failure q is :
(a) 1/3 (c) 2/3
(b) 3 (d) –1/3

(6) Number of misprints per page of a thick book follows :
(a) Binomial distribution (c) Poission distribution
(b) Normal distribution (d) Standard Normal distribution

(7) The value of probability is :
(a) Less than 0 (c) more then 0
(b) between 1 and 10 (d) between 0 and 1

(8) Which of the following is a Non-parametric test ?
(a) T test (c) Chi square
(b) F test (d) Z test

[TURN OVER

(9) Which of the following Methods of Random Sampling is used when the population is composed of diverse segments or natural subdivisions of units.
(a) Stratified Sampling (c) Multi-stage Sampling
(b) Systematic Sampling (d) Simple random Sampling

(10) The curve obtained by joining the points, whose x co-ordinates are upper class limits of the classintervals and y co-ordinates are corresponding cumulative frequencies is called
(a) Ogive (c) Histogram
(b) Frequency Polygon (d) Frequency curve

(b) Do as directed :— **10**
(1) If standard deviation of values is zero then all values of data are identical. whether the statement is **true** or **false**.
(2) _____ calculate spreading of data.
(3) Say whether the following statement is **possible** or **not possible** and briefly give your reason.
Mean of the observation is negative.
(4) In experiment of throwing a fair die :
A = {3, 4} B = {4, 5, 6}. Find $A^c \cap B$
(5) Write sample space for the following random experiment.
Tossing of two coins.
(6) _____ is the process of arranging data into sequences and groups according to their common characteristics, or separating them into different but related part.
(7) If x and y are independent, then E(xy)= E(x) + E(y), whether the statement is **true** or **false**.
(8) Any statistical measure computed from population data is known as _____.
(9) T-test is a parametric test, whether the statement is **true** or **false**.
(10) Any hypothesis which is complementary to the null hypothesis is called _____.

2. (a) Locate Mode graphically from the following data : **20**

Daily profit (in ₹)	100-140	140-180	180-200	200-220	220-240	240-260
No. of Shops	14	45	52	82	32	23

(b) Explain the purpose and importance of Classification and Tabulation of statistical data.
(c) The staff of a department consists of a manager, an officer and 10 clerks. A committee of 4 is to be selected from the department. Find the number of ways in which this can be done so as to always include (1) the manager, (2) the manager but not the officer, (3) neither the manager nor the officer.
(d) How many different 7-place license plates are possible if the first 3 places are occupied by letters and the final 4 by numbers under the assumption that no letter or number can be repeated in a single license plate ?

3. (a) Calculate Mean from the following distribution : **20**

Daily profit (in ₹)	100-140	140-180	180-200	200-220	220-240	240-260
No. of Shops	14	45	52	82	32	23

(b) The following are the runs scored by two batsmen A and B in 5 test matches. Decide who should be selected for the coming tour :
Runs by batsman A : 56, 58, 60, 62, 59
Runs by batsman B : 70, 62, 50, 35, 69

(c) The frequency distribution below represents the time in seconds needed to serve a sample of customers by cashiers at Dollar Discount store in December 1996. Find Quartile Deviation.

Time (in seconds)	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
No of Customers	6	16	21	29	25	22	11	7

(d) Compare Arithmetic Mean, Median and Mode as measure of central tendency.

4. (a) Two fair dice are rolled. X denotes the sum of the numbers appearing on the uppermost faces of the dices. From the probability distribution of X find **20**
(a) P(X is a multiple of 3) (b) P(5 < X < 10)

(b) 1500 candidates appeared for a certain examination. The mean marks were 58 with a standard deviation of 5 marks. Assuming that the distribution of marks to be Normal. Find (i) the proportion of students securing more than 63 marks. (ii) the number of students securing marks between 60 and 68.
Given : Area between z = 0 and z = 1 is 0.3413
Area between z = 0 and z = 2 is 0.4772
Area between z = 0 and z = 0.4 is 0.1554

(c) Define :—
(i) Exhaustive Event
(ii) Conditional Probability
(iii) Mutually Exclusive Event.

(d) From the past experience it is known that A can solve 3 examples out of given 5 and B can solve 4 examples out of given 7. An example is given to both of them to solve independently. Find the probability that (a) the example remains unsolved (b) the example is solved.

5. (a) State any five merits of sampling. **20**

(b) In a sample of 500 students in a college, 280 are tea drinkers and the rest are coffee drinkers. Can we conclude that the both tea and coffee are equally popular in the college at 5% level of significance ?

(c) A sample survey results show that out of 800 literate people 480 are employed whereas out of 700 illiterate people only 350 are employed. Can the difference between two proportions of employed persons be attributed to sampling fluctuations ? (Use 5% level of significance)

(d) The mean yield of wheat from the district A was 210 kgs while the standard deviation 10 kgs per acre from a sample of 100 plots. In another district B, the mean yield was 220 kgs with standard deviation 12 kgs from a sample of 150 plots. Assuming that the standard deviation of the yield in the entire state was 11 kgs. Test whether there is any significance difference between the mean yield of crops in the two districts at 5% level of significance.

F.Y.P.G.D.O.R.M. (Sem-I)

April 2017

asmi-D-FH 2017 14

Con. 293–17.

Optimisation Models - I

DT–5078

(3 Hours) **[Total Marks : 80**

N.B. :(1) Question **1** is **compulsory**.
(2) Attempt any **3** questions from question **2** to question **5**.
(3) **Each** question carries **20** marks.
(4) **Figure** to the **right** indicates marks to a sub-question.
(5) Use of **scientific**, handheld, non-programmable **calculator** is **allowed**.

1. Select the appropriate option. Write the number of the sub-question and the alphabet corresponding to the correct answer. **(1x20=20)**
   1. When the time value of money is considered,
      (a) Costs need to be discounted.
      (b) Timing of the incurrence of the costs is important.
      (c) The present value factor serves as the weight.
      (d) All of the above.
   2. While dealing with replacement situations —
      (a) the total cost of an item over a given period of n years would be equal to-Purchase Price + Maintenance Cost of n years + Value of the item after n years.
      (b) The total depreciation of the depreciable items increases with the passage of time whereas in successive years the depreciation declines.
      (c) both (a) and (b).
      (d) None of the above.
   3. The problem of replacement is not concerned about the —
      (a) items that deteriorate gradually.
      (b) items that fail suddenly.
      (c) determination of optimum replacement interval.
      (d) maintenance of an item to work out profitability.
   4. Staff replacement policy—
      (a) arises due to resignation, retirement or death of a staff member from time to time.
      (b) is like replacement policy for items whose values deteriorate gradually.
      (c) can be easily formulated because people retire at known times.
      (d) does not yield the optimum replacement interval.

[TURN OVER

(8)

5. You would like to assign the operators to the equipments that have —
   (a) the most jobs waiting to be processed.
   (b) jobs with the earliest due date.
   (c) jobs which have been waiting the longest.
   (d) all of the above.
6. Unforeseen factor that prevents the plans from actually happening is —
   (a) Equipment may develop a fault.
   (b) Additional order may arrive to be added to schedules.
   (c) Specifications may be changed.
   (d) All of the above.
7. If there are n jobs to be performed one at a time on each of the m machines M_1, M_2 — —, Mm, the possible sequences would be —
   (a) $(n!)^m$.
   (b) $(m!)^n$.
   (c) $(n)^m$.
   (d) $(m)^n$
8. In sequencing algorithm —
   (a) the selection of an appropriate order for a series of jobs is to be done on a finite service facilities.
   (b) all the jobs must be processed on a first-come-first serve basis.
   (c) a service facility can process more than one job at a time.
   (d) all the service facilities are not of different types.
9. Inventories in general are built up to —
   (a) satisfy demand during the period of replenishment.
   (b) carry reserve stocks to avoid shortages.
   (c) keep pace with the changing market conditions.
   (d) all of the above.
10. If the unit cost rises, the optimum order quantity will —
   (a) increase.
   (b) decrease.
   (c) either increase or decrease.
   (d) none of the above.
11. If the total investment in stock is limited, the best order quantity for each item will be —
   (a) greater than EOQ.
   (b) equal to EOQ.
   (c) less than EOQ.
   (d) either greater or less than EOQ.

12. If orders are placed with the size determined by EOQ, then the re-order cost component is —
    (a) greater than the holding cost component.
    (b) equal to the holding cost component.
    (c) less than the holding cost component.
    (d) either greater than or less than the holding cost component.
13. Multiple servers may be —
    (a) parallel.
    (b) in a series.
    (c) in combination of parallel and in series.
    (d) all of the above.
14. Queue can form only when —
    (a) arrivals exceed service capacity.
    (b) arrivals equal service capacity.
    (c) service facility is capable to serve all the arrivals at a time.
    (d) there are more than one service facilities.
15. Which of the following is not a key operating characteristics for a queueing system ?
    (a) average time a customer spends waiting in the system.
    (b) utilization factor.
    (c) percent idle time.
    (d) none of the above.
16. Which is of the following is not correct ?
    (a) Queueing theory deals with situations where customers arrive, wait for the service, get the service and leave the system.
    (b) Customers in queueing theory might include humans, ships, letters and so on.
    (c) A queue refers to physical presence of the customers waiting to be served.
    (d) A study of queueing theory helps the manager to establish an optimum level of service.
17. As simulation is not an analytical model, the results of simulation must be viewed as —
    (a) approximation.
    (b) exact.
    (c) unrealistic.
    (d) simplified.

18. Simulation should not be applied in all the cases because it —
    (a) requires considerable talent for model building and extensive computer programming efforts.
    (b) provides at the best approximate solution to the problem.
    (c) consumes much computer time.
    (d) all of the above.
19. The process of simulation —
    (a) is a powerful mathematical technique.
    (b) is often referred to as "Monte-Carlo" simulation.
    (c) usually requires the use of computers to solve the problem.
    (d) involves the criterion wherein the ouput of a simulation model is independent of the simulation run.
20. Simulation in the context of business problems —
    (a) is comparatively more realistic than mathematical techniques.
    (b) does not produce the optimum results.
    (c) is comparatively a costlier method of analysis.
    (d) all of the above.

2. (a) A firm works 40 hours a week and has a capacity of overtime work to the extent of 20 hours in a week. It has received seven orders to be processed on three machines A, B and C, in the order A, B, C to be delivered in a week's time from now. The process times (in hours) are recorded in the given table. **10**

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

The manager, who, in fairness, insists on performing the jobs in the sequence in which they are received, is refusing to accept an eighth order, which requires 7, 2 and 5 hours respectively on A, B and C machines, because, according to him, the eighth job would require a total of 61 hours for processing, which exceeds the firm's capacity. Advise him.

(b) The production department of a company requires 3,600 kg of raw material for manufacturing a particular item per year. It has been estimated that the cost of placing an order is Rs. 36 and the cost of carrying inventory is 25 per cent of the investment in the inventories. The price is Rs. 10 per kg. Help the purchase manager to determine an ordering policy for raw material. **10**

3. The following failure rates have been observed for a certain type of transistors in a digital computer : **20**

End of the week :	1	2	3	4	5	6	7	8
Probability of failure to date :	0.05	0.13	0.25	0.43	0.68	0.88	0.96	1.00

The cost of replacing an individual failed transistor is Rs. 1.25. The decision is made to replace all these transistors simultaneously at fixed intervals, and to replace the individual transistors as they fail in service. If the cost of group replacement is 30 paise per transistor, what is the best interval between group replacements ? At what group replacement price per transistor would a policy of strictly individual replacement become preferable to the adopted policy ?

4. Records of 100 truck loads of finished jobs arriving in a department's check-out area show the following : Checking out takes 5 minutes and checker takes care of only one truck at a time. The data is summarized in the following table : **20**

Truck inter-arrival time (min.) :	1	2	3	4	5	6	7	8	9	10	Total
Frequency	1	4	7	17	31	23	7	5	3	2	100

As soon as the trucks are checked out, the truck drivers take them to the next departments. Using Monte-Carlo simulation, determine :

(i) What is the average waiting time before service ?

(ii) What is likely to be the longest wait ?

Use the following 20 Random Numbers —

12, 81, 36, 82, 21, 74, 90, 55, 79, 70

14, 59, 62, 57, 15, 18, 74, 11, 41, 29

5. (a) Arrivals at a telephone both are considered to be Poisson with an average time of 10 minutes between one arrival and the next. The length of phone calls is assumed to be distributed exponentially, with a mean of 3 minutes. **10**

(i) What is the probability that a person arriving at the booth will have to wait ?

(ii) The telephone department will install a second booth when convinced that an arrival would expect waiting for at least 3 minutes for a phone call. By how much should the flow of arrivals increase in order to justify a second booth ?

[TURN OVER

(iii) What is the average length of the queue that forms from time to time ?

(iv) What is the probability that it will take a customer more than 10 minutes altogether to wait for the phone and complete his call ?

(b) The probability distribution of monthly sales of a certain item is as follows : **10**

Monthy sales :	0	1	2	3	4	5	6
Probability :	0.01	0.06	0.25	0.35	0.20	0.03	0.10

The cost of carrying inventory is Rs. 30 per unit per month and the cost of unit shortage is Rs. 70 per month. Determine the optimum stock level that minimizes the total expected cost.

F.Y.P.G.D.O.R.M. (Sem.I)

Liner Programming

April 2017

asmi-D-FH 2017 8

Con. 294–17. **DT–5368**

(3 Hours) **[Total Marks : 80**

N.B. :(1) Question **1** is **compulsory**.
(2) Attempt any **3** questions from Question **2** to Question **5**.
(3) **Each** question carries **20** marks.
(4) **Figure** to the **right** indicates marks to the sub-question.
(5) Graph paper will be provided on request.
(6) Use of **scientific**, handheld, **non-programmable** calculator is **allowed**.

1. Select the correct alternative. Write the number of the sub-question and the alphabet corresponding to the correct answer. **(1x20=20)**
   1. Constraints in an L.P. model represent.
      (a) Limitations.
      (b) Requirements.
      (c) Balancing Limitations and Requirements.
      (d) all of (a), (b) and (c).
   2. Non-negativity condition is an important component of an L.P. model because
      (a) the value of the variable should remain under the control of the decision maker.
      (b) the value of the variable makes sense and corresponds to the real world problems.
      (c) the variables are interrelated in terms of limited resources.
      (d) of none of the above.
   3. The shadow price is
      (a) the price which is paid for the purchase of the resources.
      (b) the savings by eliminating one of the excess quantities of the resource.
      (c) the increase in the objective function value by providing an additional unit of resource.
      (d) none of the above.
   4. Sensitivity Analysis
      (a) is also called the Post Optimality Analysis as it is carried out after the Optimal Solution is obtained.
      (b) allows the decision-maker more meaningful information about the changes in an L.P. model parameters.
      (c) provides the range within which a parameter may change without affecting Optimality.
      (d) is all of the above.

[TURN OVER

5. The Graphical Solution Set of an L.P. problem may be
   (a) a point
   (b) a straight line
   (c) a convex polygon
   (d) Either (a) or (b) or (c).
6. Before formulating a formal L.P. model it is better to
   (a) express each constraint in words.
   (b) express the objective function in words.
   (c) identify each decision variable in words.
   (d) carry out all of the above.
7. Each constraint in an L.P. model is expressed as
   (a) an inequality with $\geq$ sign.
   (b) an inequality with $\leq$ sign.
   (c) an equation with = sign.
   (d) all of the above.
8. The distinguishing feature of an L.P. model is / are
   (a) that the relationship among all the variables is linear.
   (b) that it has a single linear objective function.
   (c) that the value of the decision variable is non-negative.
   (d) all of the above.
9. The Graphical Method of a Linear Programming Problem uses
   (a) Objective function.
   (b) Constraints on resources.
   (c) Non-negativity constraints.
   (d) All of the above.
10. In the Optimal Simplex table, for a non-basic variable C_J-Z_J=0 indicates
    (a) an unbounded solution.
    (b) cycling.
    (c) an alternative solution.
    (d) an infeasible solution.
11. Dual of the Dual is
    (a) Primal
    (b) Dual
    (c) Alternative
    (d) None of these.

(15)

12. Operations Research approach is
    (a) multi-disciplinary.
    (b) Scientific.
    (c) Innovative.
    (d) All of the above.
13. A Basic Feasible Solution of an L.P. Problem is said to be _____ if at least one of the basic variables is zero
    (a) Degenerate.
    (b) Non-degenerate.
    (c) Infeasible.
    (d) Unbounded.
14. The word 'Linear' means that the relationships are represented by
    (a) diagonal lines.
    (b) Zigzag lines.
    (c) Straight lines.
    (d) Slanting lines.
15. An L.P. model is based on the assumption/s of
    (a) Proportionality.
    (b) Additivity.
    (c) Certainty.
    (d) (a) and (b) and (c).
16. An L.P. with _____ variable/s can be easily solved by the Graphical Method.
    (a) one decision.
    (b) four decision.
    (c) three decision.
    (d) two decision.
17. Which variables are fictitious and cannot have any physical meaning ?
    (a) Optimal variable.
    (b) Decision variable.
    (c) Artificial variable.
    (d) None of the above.
18. Decision variables are
    (a) Controllable.
    (b) Uncontrollable.
    (c) Parameters.
    (d) None of the above.

19. A Minimisation problem can be converted into a Maximisation problem by changing the sign of coefficients in
    (a) the Constraints.
    (b) the Objective function.
    (c) the Both (a) and (b).
    (d) None of the above.
20. Operations Research uses models to help the management to determine
    (a) its policies.
    (b) its actions.
    (c) both (a) and (b).
    (d) neither (a) and nor (b)

2. (a) A farmer has 100 acres of farm. He can sell all the Tomatoes, Lettuce and Radishes he can raise. The price he can obtain is Rs. 5.00 per kg. for Tomatoes, Rs. 3.00 a head for Lettuce and Rs. 5.00 per kg. for Radishes. The average yield per acre is 2000 kgs. of Tomatoes, 3000 heads of Lettuce and 1000 kgs. of Radishes. Fertilizer is available at Rs. 10.00 per kg and the quantity required per acre is 100 kgs each for Tomatoes and Lettuce and 50 kgs for Radishes. Labour required for sowing, cultivating and harvesting per acre is 5 man-days for Tomatoes and Radishes and 6 man days for Lettuce. A total of 400 man days of labour are available at Rs. 160.00 per man day. Formulate this as an L.P. Problem. **DO NOT SOLVE IT.** **10**

   (b) Solve the following L.P. Problem Graphically. **10**

Minimise $Z=1{\cdot}5X_1+2{\cdot}5X_2$
Subject to
$X_1+3X_2 \geq 3$
$X_1+X_2 \geq 2$
$X_1\ X_2 \geq 0$

3. Use Big M (Penalty) Method to solve the following L.P. Problem. **20**
Maximise

$Z=3X_1-X_2$
Subject to the constraints
$2X_1+X_2 \geq 2$
$X_1+3X_2 \leq 3$
$X_2 \leq 4$
$X_1\ , X_2 \geq 0$

4. (a) Consider the following Primal problem **10**

Maximize Z = 3x1 + 4x2

Subject to

$6X_1 + 4X_2 \leq 60$

$X_1 + 2X_2 \leq 22$

$X_1, X_2 \geq 0$

		Cj	3	4	0	0
C_B	Basis	Solution	X_1	X_2	S_1	S_2
3	X_1	4	1	0	1/4	-1/2
4	X_2	9	0	1	-1/8	3/4
	Zj	48	3	4	1/4	3/2
		Cj-Zj	0	0	-1/4	-3/2

(i) Write the Dual of the given Primal.

(ii) From the Solution of the Primal, write the solution of the Dual.

(iii) Give the Economic Interpretation of the Dual :

4. (b) Consider the following L.P. Problem. **10**

Maximise

$Z=2X_1+5X_2+8X_3$

Subject to

$6X_1+8X_2+4X_3 \leq 96$ (hours, Department I)

$2X_1+X_2+2X_3 \leq 40$ (hours, Department II)

$5X_1+3X_2+2X_3 \leq 60$ (hours, Department III)

$X_1, X_2, X_3 \geq 0$

Final Simplex Tableau is as follows —

		C_J	2	5	8	0	0	0
C_B	Product Mix	Quantity	X_1	X_2	X_3	S_1	S_2	S_3
5	X_2	8/3	1/3	1	0	1/6	-1/3	0
8	X_3	56/3	5/6	0	1	-1/12	2/3	0
0	S_3	44/3	7/3	0	0	-1/3	-1/3	1
	Z_j	488/3	25/3	5	8	1/6	11/3	0
		C_J-Z_J	-19/3	0	0	-1/6	-11/3	0

[TURN OVER

18

Answer the following —

(i) Write the optimum product mix and the profit contribution shown by the above solution.

(ii) Is this solution feasible ? Why ?

(iii) Does the problem have any alternative solution ? If yes find. If no state the reason.

(iv) If the company produces six units of X_1, how many units of X_2 and X_3 will have to be reduced, if any ?

(v) If a customer is prepared to pay higher price for product X_1, how much should the price be increased so that the profit of the company remains unchanged ?

5. Consider the following L.P. Problem — **20**

Maximise

$Z=4X_1+6X_2+2X_3$

Subject to

$X_1+X_2+X_3 \leq 3$ (man power)

$X_1+4X_2+7X_3 \leq 9$ (material)

$X_1, X_2, X_3 \geq 0$

The final simplex Tableau is as under —

		Cj	4	6	2	0	0
C_B	Basis	Solution	X_1	X_2	X_3	S_1	S_2
4	X_1	1	1	0	-1	4/3	-1/3
6	X_2	2	0	1	2	-1/3	1/3
	Zj	16	4	6	8	10/3	2/3
		Cj-Zj	0	0	-6	-10/3	-2/3

(i) Find the range of the values of Non-Basic variable coefficient C_3 such that the current optimum product mix remains optimal.

(ii) What happens if C_3 is increased to Rs. 12 ? What is the new product mix ?

(iii) Find the range of basic variable coefficient C_1 such that the current optimum product mix remains optimum.

(iv) Find the effect on the optimal product mix when C_1=Rs.8

(v) Find the effect of changing the objective function to $Z = 2X_1+8X_2+4X_3$ on the current optimal product mix.
