Sample Question Paper
Applied Mathematics (Code-241)
Class XII
2023-24

Time Allowed: 3 Hours   **Maximum Marks: 80**

**General Instructions :**

1. This Question paper contains - **five sections** A,B,C,D and E. Each section is compulsory. However, there is some internal choice in some questions.
2. **Section A** has 18 **MCQ's and 02** Assertion Reason based questions of 1 mark each.
3. **Section B** has 5 **Very Short Answer(VSA)** questions of 2 marks each.
4. **Section C** has 6 **Short Answer(SA)** questions of 3 marks each.
5. **Section D** has 4 **Long Answer(LA)** questions of 5 marks each.
6. **Section E** has 3 **source based/case based/passage based/integrated units of assessment (**04 marks each**)** with sub parts.
7. Internal Choice is provided **in 2 questions in Section-B, 2 questions in Section-C, 2 Questions in Section-D.** You have to attempt only one alternatives in all such questions.

SECTION A
(All Questions are compulsory. No internal choice is provided in this section)

Q -1 The value of -70 mod 13 is
(a) 5   (b) -5 (c) 8   (d)-8

Q -2 If $\frac{x+1}{x+2} \geq 1$, then
(a) $x \in [-\infty, 2]$ (b) $x \in (-\infty, -2)$ (c) $x \in (-\infty, 2]$ (d) $x \in (-\infty, 2)$

Q-3 Which of the following is a statistic
(a) μ (b) $\bar{x}$ (c) σ^2 (d) None

Q-4 In one sample t- test, the estimation for population mean is
(a) $\frac{\bar{x}-\mu}{\frac{S}{\sqrt{n}}}$ (b) $\frac{\bar{x}-\mu}{S/n}$ (c) $\frac{\bar{x}-\mu}{S^2/n}$ (d) $\frac{\overline{x_1}-\overline{x_2}}{\frac{S}{\sqrt{n}}}$

Q-5 A man can row 6 km/h in still water. It takes him twice as long to row up as to row down the river. Then the rate of the stream is
(a) $2\ km/h$ (b) $4\ km/h$ (c) $6\ km/h$ (d) $8\ km/h$

Q-6 If random variable X represents the number of heads when a coin is tossed twice then mathematical expectation of X is
(a) 0   (b) $\frac{1}{4}$ (c) $\frac{1}{2}$ (d) 1

Q-7 The least non-negative remainder when 3^{50} is divided by 7 is
(a) 4   (b) 3   c) 2   d) 1

Q-8 If the cash equivalent of a perpetuity of Rs ₹300 payable at the end of each quarter is ₹24000 then rate of interest compounded quarterly is
(a) 5%   (b) 4%   (c) 3%   (d) 2%

Q-9 $\int \frac{logx}{x} dx$ equals

(a) $\frac{logx}{2} + C$ (b) $\frac{(logx)^2}{2} + C$ (c) $logx + C$ (d)) $log\,(log\,x) + C$

Q-10 The supply of finished good was delayed for a month due to landslide in hilly terrain. Under which trend oscillation does this situation fall

(a) $Seasonal$ (b) $Cyclical$ (c) $Secular$ (d) $Irregular$

Q-11 A machine costing ₹ 30,000 is expected to have a useful life of 4 years and a final scrap value of ₹ 4000. The annual depreciation is

(a) ₹ 5500 (b) ₹ 6500   (c) ₹ 7500   (d) ₹ 8500

Q-12 The effective rate of interest equivalent to the nominal rate 6% compounded semi-annually is

(a) 6.05%   (b) 6.07%   (c) 6.09%   (d) 6.1%

**Q-13** If the investment of ₹ 20000 in the mutual fund in 2015 increased to ₹ 32000 in year 2020, then CAGR (Compound Annual Growth rate is) is [Given$(1.6)^{\frac{1}{5}} = 1.098$]

(a) 9.08%   (b) 9.8%   (c) 0.098   (d) 0.09

Q-14 The integrating factor of the differential equation $x\frac{dy}{dx} + 2y = x^3$ $(x \neq 0)$ is

(a) x (b) $logx$ (c) x^2 (d) $\frac{1}{x^2}$

Q-15 Besides non negativity constraint the figure given below is subject to which of the following constraints
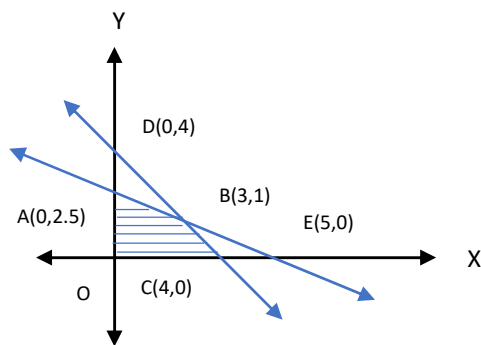
(a) $x + 2y \leq 5 ; x + y \leq 4$ (b) $x + 2y \geq 5 ; x + y \leq 4$
(c) $x + 2y \geq 5 ; x + y \geq 4$ (d) $x + 2y \leq 5 ; x + y \geq 4$

Q-16 If X is a Poisson variate such that 3P(X=2) = 2P(X=1) then the mean of the distribution is equal to

(a) $\frac{4}{3}$ (b) $\frac{3}{4}$ (c) $-\frac{4}{3}$ (d) $-\frac{3}{4}$

Q-17 For the given five values 35, 70, 36, 59, 64, the three years moving averages are given by

(a)47, 53, 55   (b) 53, 47, 45   (c) 47, 55, 53 (d) 45, 55, 57

Q-18 The data point of a normal variate with mean 12, standard deviation 4 and Z – score 5 is

(a) 28   (b) 304   (c) 34   (d) 32

ASSERTION REASON BASED QUESTIONS

In the following questions, a statement of Assertion(A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices

a. Both A and R are true and R is the correct explanation of A.
b. Both A and R are true and R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

Q-19 Assertion (A): The maximum profit that a company makes if profit function is given by $P(x) = 41 + 24x - 8x^2$; where 'x' is the number of units and P is the profit is ₹59

Reason (R) : The profit is maximum at $x = a$ if $P'(a) = 0$ and $P''(a) > 0$

Q-20 Assertion (A) : The probability of getting 6 heads when a unbiased coin is tossed 10 times is $C(10,6)\left(\frac{1}{2}\right)^{10}$

Reason (R) In a Binomial distribution the probability is given by $P(X = r) = C(n, r)(p)^r(q)^{n-r}$

SECTION B

All Questions are compulsory. In case of internal Choice, attempt any one question only

Q-21 At what rate of interest will the present value of perpetuity of ₹1500 payable at the end of every 6 months be ₹20,000?

Q-22 If A is a square matrix $\begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix}$ such that $A^2 = pA$, then find the value of p.

OR

If $\begin{bmatrix} 0 & a & 3 \\ 2 & b & -1 \\ c & 1 & 0 \end{bmatrix}$ is skew -symmetric matrix, then find value of $a+b+c$

Q-23 A Cooperative Society of farmers has 10 hectares of land to grow two crops A and B. To control weeds, pesticide has to be used for crops A and B at the rate of 30 grams per hectare and 15 grams per hectare respectively. Further, not more than 750 grams of pesticide should be used. The profit from crops A and B per hectare are estimated as ₹8000 and ₹9500. Formulate the above problem as LPP, in order to allocate land to each crop for maximum total profit.

Q-24 A man rows 15km upstream and 25km downstream each in 5 hours. Find he speed of the stream.

OR

'A' can run 40 meters while 'B' runs 50 meters in the same time. In a 1000 m race, find by how much distance 'B' beats 'A'.

Q-25 A machine produces washers of thickness 0.50mm. To determine whether the machine is in proper working order, a sample of 10 washers is chosen for which the mean thickness is 0.53mm and the standard deviation is 0.03mm. Test the hypothesis at 5% level of significance that the machine is working in proper order.
[Given $t_{9(0.05)} = 2.262$]

SECTION C
All Questions are compulsory. In case of internal Choice, attempt any one question only

Q-26 Find: $\int \frac{x^3}{(x+2)} dx$

OR

Find: $\int (x^2 + 1) \log x \ dx$

Q-27 Cost of two toys A and B are ₹50 and ₹75. On a particular Sunday shopkeeper P sells 7 toys of type A and 10 toys of type B whereas shopkeeper Q sells 8 toys of type A and 6 toys of type B. Find income of both shopkeepers using matrix Algebra.

Q-28 Find the intervals in which the function f(x) = $2x^3 - 9x^2 + 12x - 5$ is increasing or decreasing.

Q-29 The demand and supply functions under the pure market competition are $p_d = 16 - x^2$ and $p_s = 2x^2 + 4$ respectively, where p is the price and x is the quantity of the commodity. Using integrals find **Consumer's surplus**.

OR

The demand and supply functions under the pure market competition are $p_d = 56 - x^2$ and $p_s = 8 + \frac{x^2}{3}$ respectively, where p is the price and x is the quantity of the commodity. Using integrals find **Producer's surplus.**

Q-30 Mr Surya borrowed a sum of ₹5,00,000 with total interest to be paid ₹2,00,000(flat) and he is paying an EMI of ₹12,500. Calculate loan tenure.

Q-31 Mr Sharma wants to send his daughter abroad for higher studies after 10 years. He sets up a sinking fund in order to have ₹500,000 after 10 years. How much should he set aside semi-annually into an account paying 5% per annum compounded annually.
[Use $(1.025)^{20}$= 1.6386]

SECTION D
(This section comprises of long answer type questions (LA) of 5 mark each)

Q-32 On doing the proof reading of a book on an average 4 errors in 10 pages were detected. Using Poisson's distribution find the probability of (i) No error and (ii) one error in 1000 pages of first printed edition of the book (Given $e^{-0.4}$ = 0.6703)

OR

How many times Sunil toss a fair coin so that the probability of getting at least one head is more than 90 %

Q-33 A manufacturer has three machines I,II and III installed in his factory. Machines I and II are capable of being operated for at most 12 hours whereas machine III must be operated for at least 5 hours a day. He produces only two items M and N , each requiring the use of all the three machines. The number of hours required for producing 1 unit of M and N on three machines are given in the following table:

Items	Number of hours required on machines		
	I	II	III
M	1	2	1
N	2	1	1.25

He makes a profit of ₹600 and ₹400 on one unit of items M and N respectively. Formulate the above problem as LPP and solve it graphically to find how many units of each item be produced to maximize profit. Also find the maximum profit.

Q-34 A company produces a certain commodity with ₹2400 fixed cost. The variable cost is estimated to be 25% of the total revenue received on selling the product at a rate of ₹8 per unit. Find the following
  (i) Cost Function.   (ii) Revenue Function
  (iii) Breakeven Point   (iv) Profit Function
<div align="center">OR</div>

The production manager of a company plans to include 180 sq cm of actual printed matter in each page of a book under production. Each page should have a 2.5 cm wide margin along the top and bottom and 2 cm wide margin along the sides. What are the most economical dimensions of each printed page?

Q-35 The management committee of a Welfare Club decided to award some of its members (say x) for sincerity, some (say y) for helping others selflessly and some others (say z) for effective management. The sum of all the awardees is 12. Three times the sum of all awardees for helping others selflessly and effective management added to two times the number of awardees for sincerity is 33. If the sum of the number of awardees for sincerity and effective management is twice the number of awardees for helping others, use matrix method to find the number of awardees of each category.

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SECTION E
(This section comprises of 3 source based questions (Case Studies) of 4 mark each)

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Q-36 Case Study 1 : Pipes and Cisterns (Mark 2+1+1) (Internal choice is in the iii part)

A, B and C are three pipes connected to a tank. A and B together fill the tank in 6 hours. B and C together fill the tank in 10 hours. A and C together fill the tank in $7\frac{1}{2}\ hours$. Based on above information answer the following questions.
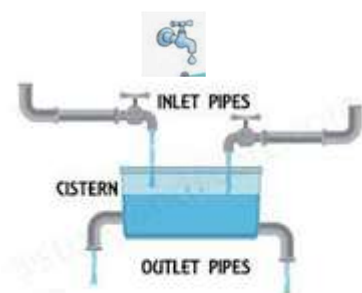
  (i) In how much time will A, B and C fill the tank?
  (ii) In how much time will A separately fill the tank?
  (iii) In how much time will B separately fill the tank?
<div align="center">OR</div>

In how much time will C separately fill the tank?

Q-37 Case Study 2: Read the following passage and answer the questions given below (**Internal Choice is in option iii**.) (Mark $1 + 1 + 2$)

Let X denote the number of hours a person watches television during a randomly selected day. The probability that X can take the values x_i, has the following form, where 'k' is some unknown constant.

$$P(X = x_i) = \begin{cases} 0.2, & \text{if } x_i = 0 \\ kx_i, & \text{if } x_i = 1 \text{ or } 2 \\ k(5 - x_i), & \text{if } x_i = 3 \\ 0, & otherwise \end{cases}$$

(i)   Find the value of k.
(ii) What is the probability that a person watches two hours of television on a selected day?
(iii) What is the probability that the person watches at least two hours of television on a selected day ?

OR

(iv) What is the probability that the person watches at most two hours of television on a selected day ?

Q-38 Case Study 3 :

When observed over a long period of time, a time series data can predict trend that can forecast increase or decrease or stagnation of a variable under consideration. Such analytical studies can benefit a business for forecasting or prediction of future estimated sales or production

The table below shows the welfare expenses(in lakh ₹) of Steel Industry during 2001-2005. Fit a straight line trend by the method of least squares and estimate the trend for the year 2008.

Year	2001	2002	2003	2004	2005
Welfare expenses	160	185	220	300	510

OR

The annual rainfall(in mm) was recorded in Cherrapunji, Meghalaya

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Rainfall(in mm)	1.2	1.9	2	1.4	2.1	1.3	1.8	1.1	1.3

Determine the trend of rainfall by three years moving average and draw the moving averages graph.