B.K. BIRLA CENTRE FOR EDUCATION
SARALA BIRLA GROUP OF SCHOOLS
A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL

NABET

PRE BOARD 2 (2025-26)
APPLIED MATHEMATICS-SET 2

Class: XII   **Time: 3hrs**
Date: 11 -12-25   **Max Marks: 80**
Admission no: **Roll no:**

General Instructions:
1. This Question Paper has 5 Sections A, B, C, D and E.
2. Section A has 20 MCQs carrying 1 mark each
3. Section B has 5 questions carrying 02 marks each.
4. Section C has 6 questions carrying 03 marks each.
5. Section D has 4 questions carrying 05 marks each.
6. Section E has 3 case-based integrated units of assessment (04 marks each) with sub-parts.
7. All Questions are compulsory. However, an internal choice in 2 Qs of 5 marks, 2 Qs of 3 marks and 2 Questions of 2 marks have been provided. An internal choice has been provided in the 2marks questions of Section E
8. Draw neat figures wherever required. Take π =22/7 wherever required if not stated.

SECTION-A

1. The value of $(486 + 729)$ mod12 is   1M

   (a) 4   (b) 2   (c) 3   (d) 1

2. The value of -31 mod 7 will be   1M

   (a) 1   (b) 2   (c) 3   (d) 4

3. If $a > b$ and $c < 0$ then which of the following is true ?   1M

   (a) a+c < b+c   (b) a-c < b-c   (c) ac > bc   (d) a-c > b+c

4. Two pipes A and B can fill a tank in 18 h and 12 h .If both the pipes are opened simultaneously then the time taken to fill tha tank is   1M

   (a) 35 minutes   (b) 64 minutes   (c) 36 minutes   (d) 8 minutes

5. The matrix $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$ is   1M

(a) a unit matrix (b) a symm. matrix (c) a skew symm. matrix   (d) a diagonal matrix

6. If $\begin{pmatrix} a+b & 2 \\ 5 & b \end{pmatrix} = \begin{bmatrix} 6 & 5 \\ 2 & 2 \end{bmatrix}^T$, then a is   1M

   (a) 4   (b) 3   (c) 2   (d) 1

7. If A is 3x3 matrix such that $|A|=8$, then $|3A|$ is equals   1M

    (a) 24   (b) 72   (c) 216   (d) 8

8. If x=3at,   y=at^3 , then $\frac{dy}{dx}$ is equal to   1M

    (a)3   (b)3a   (c) 3at   (d) t^2

9. The radius of a circle is increasing at the rate of 0.7cm/s. Then the rate of increase of its circumference
is   1M

(a) 1.4π cm/s   (b) 2.4 cm/s   (c) 0.4 cm/s   (d) -0.4 cm/s

10. The total revenue in Rupees received from the sale of x units of a product is given by

    R(x)= $3x^2$+36x+5. The marginal revenue , when x=15 is: 1M

(a)116   (b) 96   (c) 90   (d)126

11. The probability distribution of a discrete random variable X is given below :   1M

X	2	3	4	5
P(X)	5/k	7/k	9/k	11/k

The value of k is

   (a) 8   (b)   16   (c) 32   (d) 48

12. Consider the following hypothesis test   1M

$H_0 : \mu \leq 25$ $H_a : \mu > 25$

A sample of 40 provided a sample mean of 26.4, then the value of the test statistics is:

(a) 4.18   (b)-1.48   (c) 1.48   (d)-4.18

13. A specific characteristic of a population is known as a   1M

   (a) a sample   (b) parameter   (c) statistic   (d) mean

14. Which of the following cannot be a component for a time series   1M

(a) seasonality   (b) trend   (c) cyclical   (d) none of these

15. Seasonal variation mean the variations occurred within   1M

(a) A number of years (b) parts of a year (c) parts   of a month   (d) none of these

16. Time series data have a total number of components?   1M

(a) 3   (b) 4   (c)5   (d) 6

17. Mr. Anil takes a loan of Rs. 2,00,000 with 10% annual interest rate for 5 years. EMI under flat rates system is   1M

(a) 4000   (b) 5000   (c) 6000   (d)7000

18. At what rate of interest will the present value of a perpetuity of Rs. 500 payable at the end of every 6 months be Rs. 10000?   1M

(a) 6   (b) 8   (c)5   (d)10

19. Assertion (A): Feasible region is the set of points which satisfy all of the given constraints.

Reason (R): The optimal value of the objective function is attained at the points on X-axis only.

     (a)   Both A and R are true and R is the correct explanation for A
     (b)   Both A and R are true but R is NOT the correct explanation of A
     (c)   A is true but R is false.
     (d)   A is false but R is true.   1M

20. Assertion (A): The function y= $[x\,(x-2)]^2$ is increasing in (0,1) U (2 , ∞)

Reason (R): $\frac{dy}{dx} = 0$, when x=0,1,2

     (a)   Both A and R are true and R is the correct explanation for A
     (b)   Both A and R are true but R is NOT the correct explanation of A
     (c)   A is true but R is false.
     (d)   A is false but R is true.   1M

<div align="center">SECTION –B</div>

21. Find the value of x, given that $x \equiv 23(mod\ 7)$; if $21 \le x < 31$ 2M

22. In a 500 m race, A defeats B by 60 meters (or) 12 seconds. What is the time taken by A to complete the race?   2M

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

A pump can fill a tank with water in 2 hours. Because of a leak in the tank, it takes $2\frac{1}{3}$ hours to fill the tank. The leak will be empty the filled tank in what time?

23. Construct a matrix of order 2 x 3 , whose elements are given by $a_{ij} = (i+2j)/2$.   2M

24. A person has an initial investment of Rs. 50000 in an investment plan. After 2 years it has grown to Rs 60000. Find his rate of return.   2M

25. A small firm manufactures necklaces and bracelets. The total number of necklaces and bracelets that it can handle per day is at most 24. It takes one hour to make a bracelet and half an hour to make a necklace. The maximum number of hours available per day is 16. If the profit on a necklace is Rs 100 and that on a bracelet is Rs.300. Formulate a L.P.P. for finding how many of each should be produced daily to maximise the profit?   2M

SECTION-C

26. Three pipes A,B and C can fill a tank together in 8 h .After working at it together for 2 h,B is closed and A and C can fill the remaining part in 12 h.Find the time in which B alone can fill the tank.   3M

OR

Two pipes can fill a tank in 20 min and 24 min, respectively and a waste pipe can empty 4 gallons of water per minute. If all the three pipes working together can fill tank in 15 min, then find the capacity of the tank.

27. A vehicle costing Rs. 900000 has a scrap value of Rs. 270000. If the annual depreciation charge is Rs. 70000, Find its useful life in years.   3M

28. Calculate the 3 yearly moving averages from the following time series: 3M

Year	2005	2006	2007	2008	2009	2010	2011	2012
Earnings: (Rs Lakhs)	3.6	4.3	4.3	3.4	4.4	5.4	3.4	2.4

29. Find the present value of a perpetuity of Rs 3120 payable at the beginning of each year , if money is worth 6% effective.   3M

30. Find the intervals in which the function is $f(x) = 2x^3 + 9x^2 + 12x + 20$ 3M

    (1) increasing (2) decreasing

OR

If a manufacturer's total cost function C is given by $C= \frac{x^2}{25} + 2x,$ find (i) average cost function (ii) the marginal cost function, and (iii) the marginal cost when 5 units are produced. Also, interpret the result.

31. A company has been producing steel tubes of mean inner diameter of 2 cm. A sample of 10 tubes gives an inner diameter of 2.01 cm and a variance of .004 cm^2. Is the difference in the values of means significant? (Given $t_9(.05) = 2.262$)   3M

SECTION-D

32. A company produces two types of products, A and B. The company is limited by a constraint on the number of labour hours available, which is 500 hours. Product A requires 4 hours of labour per unit, while Product B requires 6 hours of labour per unit. Additionally, the company is restricted by a maximum of 80 units of product A and 60 units of product B that can be produced per day. The profit per unit of product A is ₹ 30, and the profit per unit of product B is ₹ 40. Formulate the Linear Programming Problem (LPP) to maximize the profit.   5M

33. Integrate: $\frac{3x-2}{(x+1)(x-2)^2}$ w.r.t x   OR $\int_1^4 |x - 5| \ dx$ 5M

34. Mr. Sharma plans to buy a car worth ₹ 10,00,000. He makes a down payment of 20% of the car price and takes a loan for the remaining amount. The loan is to be repaid in 5 years with an annual

interest rate of 10%, compounded monthly. Calculate the monthly EMI using the reducing balance method and the total interest paid over the loan period. [Use $(1.0083)^{60} = 1.64$]
5M

35. An urn contains 3 white balls and 6 red balls. Four balls are drawn one by one with replacement. Find the probability distribution of the number of red balls drawn. Hence, find the mean and variance of the distribution   5M

OR

In an examination, 2000 students appeared and the mean of the normal distribution of marks is 30 with standard deviation as 6.25. Find out how many students are expected to score (1) between 20 and 40 marks (2) less than 25 marks

SECTION- E (CASE BASED QUESTION)

36. In year 2000, Mr. Talwar took a home loan of Rs.30,00000 from state Bank of India at 7.5%p.a. compounded monthly for 20 years. $(1.00625)^{240} = 4.4608$
Based on the above information, answer the following question
i. What was EMI paid by Mr. Talwar

ii. What was interest paid by Mr. Talwar in 150th payment?
iii. What was Principal paid by Mr. Talwar in 150th payment?
Or
What was the outstanding loan balance immediately after the 150th payment?   4M
37. The mathematics scores of a group of 500 students follow a normal distribution with a mean of 75 and a standard deviation of 8. Based on this data, answer the following questions:
 (i) What percentage of students scored below 75 marks?
 (ii) Find the number of students who scored more than 82 marks.
 (iii) Calculate the number of students scoring between 67 and 83 marks.
OR
The top 10% of students are awarded a scholarship. The Z-score for the 90th percentile is 1.28.
       Determine the minimum score required to qualify for the scholarship.
       Use $P(Z < 0.875) = 0.8092$, $P(Z < 1) = 0.8413$, $P(Z < -1) = 0.1587$ 4M
38. Radium decomposes at a rate proportional to the quantity of radium present. Suppose that it is found that in 25 years approximately 1.1 % of a certain quantity of radium has decomposed   4M

Based on the above information answer the following questions:
(i)Formulate the differential equation for the amount of radium decomposed in time t.
(ii) If p and q denotes the order and degree of the differential equation in (1) respectively. find $2p + 3q$.
(iii) Write the expression for the amount of radium decomposed in time t and the amount of radium present at t=0
OR
 (iii)Compute the value of proportionality constant appearing in the differential equation of part (ii)