Time : 2½ Hours   **MATHEMATICS AND STATISTICS**
                                              (New Pattern)

Subject Code

| H | 6 | 0 | 6 |

Total No. of Questions : 30   **(Printed Pages : 7)**   **Maximum Marks : 80**

INSTRUCTIONS : 1) *All* questions are **compulsory**.
2) *The question paper consists of* **30** *questions divided into* **five** *Sections –* **A, B, C, D** *and* **E**.
3) *Section –* **A** *contains* **7** *questions of* **1** *mark* **each**, *which are multiple choice type questions. Section –* **B** *contains* **7** *questions of* **2** *marks* **each**, *Section –* **C** *contains* **7** *questions of* **3** *marks* **each**, *Section –* **D** *contains* **7** *questions of* **4** *marks* **each** *and Section –* **E** *contains* **2** *questions of* **5** *marks* **each**.
4) *There is* **no** *overall choice in the paper. However* **internal** *choice is provided in* **2** *questions of* **3** *marks* **each**, **2** *questions of* **4** *marks* **each** *and* **2** *questions of* **5** *marks. In questions with choices only* **one** *of the choices is to be attempted.*
5) **Use** *of calculators is not* **permitted**.
6) **Log** *tables will be supplied* **on request**.
7) *Graphs should be drawn on the answer paper only.*

SECTION – A

Question numbers **1** to **7** carry **1** mark **each**. In **each** question, **four** options are provided, out of which **one** is correct. Select and write the correct option :

1. If any two rows or columns of a determinant are identical, then value of the determinant is _____

   • 1   • – 1   • 0   • 2

.

2. If $\begin{vmatrix} x+1 & 8 \\ 3 & 4 \end{vmatrix} = 8,$ then x is _____

   - x = 0
   - x = 4
   - x = 7
   - x = 3

3. If a function $f : R \rightarrow R$ is defined as f(x) = 2x + 3, then (f ∘ f) (1) is _____

   - 1
   - 13
   - 5
   - 10

4. $\int \cot x \, dx =$ _____

   - log | secx| + c
   - log |sinx| + c
   - log |secx + tanx| + c
   - log $|\tan \frac{x}{2}|$ + c

5. The interest on the present value of a bill of exchange is known as _____

   - Banker's discount
   - True discount
   - Banker's gain
   - Discounted value

6. Gauri invested ₹ 2,000 for 4 months and Seema invested ₹ 3,000 for 8 months in a partnership deed. Then the adjusted capital ratio is _____

   - 1 : 3
   - 3 : 1
   - 2 : 3
   - 3 : 2

7. The future value of an ordinary annuity of ₹ 1,000 a year, for 3 years at 5% per annum, compounded annually (Given $S_{\overline{3}10.05} = 3.1525$, $S_{\overline{3}10.025} = 3.0756$) is _____

   - 3152.5
   - 3.1525
   - 3075.6
   - 307.56

SECTION – B

Question numbers **8** to **14** carry **2** marks **each** :

8. If $A' = \begin{bmatrix} 3 & 4 \\ -1 & 2 \\ 0 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 2 & 1 \\ 1 & 2 & 3 \end{bmatrix}$, where A′ is transpose of A. Find $(3A + B)'$.

9. If $f(x) = 3^{4x}$, find the derivative of f(x) with respect to x, using first principle.

10. If $\int_{1}^{2}[8x^3 - 2x + 6K]dx = 3$. Find value of K.

11. Evaluate $\int e^x\left[1 - \cot x + \cot^2 x\right] dx$.

12. A company manufactures fans and sewing machines. The company has only ₹ 5,760 to invest and can manufacture atmost 200 items. The cost of manufacturing a fan is ₹ 360 and a sewing machine is ₹ 240. The profit that the company gets on a sale of a fan is ₹ 22 and a sewing machine is ₹ 18. Write the objective function and the constraints to maximize the profit.

13. The probability that a certain person will buy a shirt is 0.2, the probability that he will buy a trouser is 0.3 and the probability that he will buy a shirt given that he buys a trouser is 0.4. Find the probability that he will buy both a shirt and a trouser. Also find the probability that he will buy a trouser given that he buys a shirt.

14. Define "Present Worth" of a firm and "Profit sharing ratio" in a partnership deed.

SECTION – C

Question numbers **15** to **21** carry **3** marks **each** :

15. On the set R of real numbers binary operation $*$ is defined by $a * b = (a - b)^2$. Determine, whether $*$ is commutative and associative.

16. If $y = 2^{x+y}$, show that $\dfrac{dy}{dx} = \dfrac{y \log 2}{1 - y \log 2}$.

17. If $x = \dfrac{t^2 - 1}{2t}$, $y = \dfrac{t+2}{4t}$, find $\dfrac{dy}{dx}$ at t = 2.

18. Evaluate $\displaystyle\int_{1}^{2} x^2 \log x\ dx$.

OR

Evaluate $\displaystyle\int_{0}^{1} x^2 \sqrt{1-x}\ dx$.

19. Form a differential equation by eliminating the arbitrary constants a and b from $y = (a + bx)\ e^{5x}$.

20. Solve the differential equation $(2x^2 + 1)\ dy + x\sin y\ dx = 0$. Hence find particular solution when $x = y = \dfrac{\pi}{2}$.

21. Gurmeet, Ram and Rahim are partners in business and decide to share the profits and losses in the ratio 5 : 6 : 7. Ram took retirement from the partnership. The new profit sharing ratio of Gurmeet and Rahim is 20 : 34. Find the gaining ratio. Also find the share of Gurmeet from the profit of ₹ 1,08,000 after retirement of Ram.

OR

Priti, Niki and Nishu enter into a partnership investing ₹ 60,000, ₹ 36,000 and ₹ 30,000 respectively. It was agreed that after allowing $\dfrac{1}{8}^{\text{th}}$ of the profits to Nishu as a manager, the remaining profits will be divided among the partners in the ratio of their capitals. At the end of the year, Nishu received ₹ 8,000. What was the total profit of the business and how much did Priti and Niki receive ?

SECTION – D

Question numbers **22** to **28** carry **4** marks **each** :

22. Solve the following system of equations by using the matrix method :

    $x + 2y + 3z = 20$

    $2x - y + z = 5$

    $3x + 2y - z = 8.$

23. By using properties of determinants, show that $\begin{vmatrix} 1 & y & y^2 \\ y^2 & 1 & y \\ y & y^2 & 1 \end{vmatrix} = (1-y)^2 (1+y+y^2)^2.$

24. Discuss the continuity of the function :

$$f(x) = \frac{x^2 - 4\sin x}{x} \quad -1 < x < 0$$

$$= \frac{x - 24}{x + 3} + 4 \quad x = 0$$

$$= \frac{\log(1 + 8x)}{-2x} \quad 0 < x < 1$$

    at x = 0.

25. Evaluate $\displaystyle\int \frac{1\,dx}{x\,\sqrt{6(\log x)^2 + 7\log x + 2}}.$

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

Evaluate $\displaystyle\int \frac{14\sin x + 8\cos x}{2\sin x + 3\cos x}\,dx.$

26. Solve the following linear programming problem graphically :

Maximize Z = 50x + 15y

Subject to the constraints :

$$5x + y \leq 100$$
$$x + y \leq 60$$
$$x, y \geq 0.$$

27. There are 6 boys and 4 girls in Room A and 8 boys and 2 girls in Room B. A student is selected at random from one of the two rooms for the post of class representative. What is the probability that the student is from Room A, given that the class representative is a boy.

OR

Past experience shows that 80% of the surgeries performed by a doctor are successful. If he performs 2 surgeries in a day. Find the probability distribution of the number of successful surgeries performed by the doctor.

28. A bill was drawn on 20th July, 2016 at 3 months after sight and was accepted on presentation on 1st August 2016. It was discounted on 23rd August 2016 at 5% p.a. interest for ₹ 7,920. Find the face value of the bill.

SECTION – E

Question numbers **29** to **30** carry **5** marks **each** :

29. If the average cost function of an article manufactured by a company is given by

$AC = \dfrac{1}{300}x^2 - 5x + \dfrac{100}{x}$. Find the output at which the Marginal Cost is minimum.

OR

A manufacturer finds that his product can be assembled at a total cost

C(x) = ₹ (200 + 30x), where x is the number of units manufactured. Assume

that the price at which he can sell each is given by $p = ₹\left(150 - \dfrac{x}{3}\right)$. What level

of production will maximize the total profit ? What is the price at this level of production ?

30. Anupam Sehgal buys a house worth ₹ 2,50,000. The contract is that Mr. Sehgal will pay ₹ 1,00,000 immediately and the balance in 15 equal annual instalments at the end of each year with 15% p.a. compound interest. Find the amount of each instalment. (Use log table).

OR

Rajan wants to accumulate ₹ 5,00,000 to send his son abroad for further studies after 4 years. How much should he save at the beginning of each year to accumulate this amount for 4 years, if money is worth 6% compounded annually. (Use log table).

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