



**FEDERAL PUBLIC SERVICE COMMISSION  
COMPETITIVE EXAMINATION-2019  
FOR RECRUITMENT TO POSTS IN BS-17  
UNDER THE FEDERAL GOVERNMENT**

Roll Number

**APPLIED MATHEMATICS**

<b>TIME ALLOWED: THREE HOURS</b>	<b>MAXIMUM MARKS = 100</b>
<p><b>NOTE:</b>(i) Attempt <b>ONLY FIVE</b> questions. <b>ALL</b> questions carry <b>EQUAL</b> marks</p> <p>(ii) All the parts (if any) of each Question must be attempted at one place instead of at different places.</p> <p>(iii) Candidate must write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.</p> <p>(iv) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.</p> <p>(v) Extra attempt of any question or any part of the attempted question will not be considered.</p> <p>(vi) <b>Use of Calculator is allowed.</b></p>	

**Q. No. 1.** (a) Find the directional derivative of  $f(x, y, z) = x^2y + yz^2$  at the point  $(2, -1, 1)$  in the direction of the vector  $i + 2j + 2k$ ? (10)

(b) Evaluate  $\int_c (xy + y^2)dx + x^2dy$  where  $c$  is bounded by the line  $y = x$  and the curve  $y = x^2$  (10)

**Q. No. 2.** (a) Find the constants  $a, b,$  and  $c$  so that  
 $F = (x + 2y + az)i + (bx - 3y - z)j + (4x + cy + 2z)k$   
 is irrotational and hence find the function  $\psi$  such that  $F = \nabla \psi$  (10)

(b) The forces  $F_1, F_2, F_3, F_4, F_5$  and  $F_6$  act along the sides of a regular hexagone taken in order. Verify that all the forces will be in equilibrium if,  
 $\sum F = 0,$  and  $F_1 - F_4 = F_3 - F_6 = F_5 - F_2.$  (10)

**Q. No. 3.** (a) A system of forces acts on a plate in the form of an equilateral triangle of side  $2a.$  The moment of the forces about the three vertices are  $M_1, M_2$  and  $M_3$  respectively. Find the magnitudes of the resultant. (10)

(b) If a particle  $P$  move with a velocity  $V$  given by  $V^2 = n^2(ax^2 + 2bx + c).$  Show that  $P$  executes a simple harmonic motion. Find the centre, the amplitude and the time period of the motion? (10)

**Q. No. 4.** (a) What is the difference between linear differential equation and Bernoulli's equation? Also find the solution of the following differential equation. (10)

$$x \left[ \frac{dy}{dx} + y \right] = 1 - y$$

(b) Use the method of undetermined coefficient to solve the following differential equation. (10)

$$y'' - 3y' + 2y = 2x^3 - 9x^2 + 6x$$

**Q. No. 5.** (a) Solve the equation (10)

$$0 = \frac{1}{2} + \frac{1}{4}x^2 - x \sin x - \frac{1}{2} \cos 2x \quad \text{with } x_0 = \frac{\pi}{2}$$

(b) Derive two point Gaussian integration formula for the following integral and use it to solve the integral. (10)

$$\int_1^{1.6} \frac{2x}{x^2 - 4} dx$$

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- Q. No. 6. (a)** Determine the second degree polynomials by using Newton's method. Also estimate the value of  $f(0.1)$  and  $f(0.5)$  for the data. **(10)**

$x$	0.0	0.2	0.4	0.6
$f(x)$	15.0	21.0	30.0	51.0

- (b)** Does the dominate diagonal is necessary for finding the numerical solution of system of linear equations by using Gauss Jacobi's and Gauss Seidal methods. Explain the reason. In what conditions a numerical method is used instead of analytical method? Find the solution of the following system by performing three iterations of Gauss Seidal method. **(10)**

$$\begin{aligned} 6x - 3y + z &= 11 \\ 2x + y - 8z &= 15 \\ x - 7y + z &= 10 \end{aligned}$$

- Q. No. 7. (a)** Define even function and odd function with examples. Verify that the Fourier **(10)**

Series for the function  $f(x) = \begin{cases} 0 & \text{When } 0 < x < \pi \\ 1 & \text{When } \pi < x < 2\pi \end{cases}$

is  $f(x) = \frac{1}{2} - \frac{2}{\pi} (\sin x + \frac{1}{3} \sin 3x + \frac{1}{5} \sin 5x + \dots)$

- (b)** Solve the following partial differential equation by using method of separable variable. **(10)**

$$\frac{\partial u}{\partial x} = 2 \frac{\partial u}{\partial t} + u, \quad \text{given } u(x, 0) = 6e^{-3x}$$

- Q. No. 8. (a)** The Trapezoidal rule applied to  $\int_0^2 f(x) dx$  gives the value 4, and the Simpson's rule gives value 2, what is the value of  $f(1)$ ? **(10)**

- (b)** Find the first two derivatives at  $x=1.1$  and  $x=1$  from the following data table. **(10)**

$x$	1	1.2	1.4	1.6	1.8	2.0
$f(x)$	0.000	0.1280	0.5440	1.2960	2.4320	4.000

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