



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

Roll Number

APPLIED MATHEMATICS

TIME ALLOWED: THREE HOURS

MAXIMUM MARKS = 100

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

Q. No. 1. (a) Find the directional derivative of $f(x, y, z) = xy^2 + yz^2$ 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 **(10)**
 $F = (x + 2y + az)i + (bx - 3y - z)j + (4x + cy + 2z)k$
is irrotational and hence find the function ψ such that $F = \nabla \psi$

(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, **(10)**
 $\sum F = 0$, and $F_1 - F_4 = F_3 - F_6 = F_5 - F_2$.

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)**

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

- 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 itrations of Gauss Seidal method. (10)
- $6x - 3y + z = 11$
 $2x + y - 8z = 15$
 $x - 7y + z = 10$

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

- (b) Solve the following partial differential equation by using method of separable variable. (10)
- $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$, 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
