

FEDERAL PUBLIC SERVICE COMMISSION

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COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2013

Roll Number

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APPLIED MATHEMATICS, PAPER-II

TIME ALLOWED: THREE HOURS

MAXIMUM MARKS: 100

- NOTE:**
- (i) Candidate must write **Q. No.** in the **Answer Book** in accordance with **Q. No.** in the **Q. Paper.**
 - (ii) Attempt **FIVE** questions in all by selecting **TWO** questions from **SECTION-A** and **ONE** question from **SECTION-B** and **TWO** questions from **SECTION-C** **ALL** questions carry **EQUAL** marks.
 - (iii) Extra attempt of any question or any part of the attempted question will not be considered.
 - (iv) **Use of Calculator is allowed.**

SECTION-A

Q.No.1. Solve the following equations:

(a) $\frac{d^3 y}{dx^3} + \frac{dy}{dx} = \sec^2 x$ (10)

(b) $\frac{2dy}{dx} - \frac{x}{y} + x^3 \cos y = 0$ (10)

Q.No.2. (a) Find the power series solution of the differential equation (10)
 $(1 - x^2)y'' - 2xy' + 2y = 0$, about the point $x=0$.

(b) Solve $Z(x+y) \frac{\partial Z}{\partial x} + Z(x-y) \frac{\partial Z}{\partial y} = (x^2 + y^2)$. (10)

Q.No.3. (a) Classify the following equations: (5)

(i) $\frac{\partial^2 Z}{\partial x^2} + x^2 \frac{\partial^2 Z}{\partial y^2} - \frac{1}{x} \frac{\partial Z}{\partial x} = 0$

(ii) $x^2 \frac{\partial^2 Z}{\partial x^2} + 2xy \frac{\partial^2 Z}{\partial x \partial y} + y^2 \frac{\partial^2 Z}{\partial y^2} = 4x^2$

(b) Solve: $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$, $-1 < x < 1, t > 0$ (15)

$u(-1, t) = u(1, t); \frac{\partial u}{\partial x}(-1, t) = \frac{\partial u}{\partial x}(1, t)$ for $t > 0$

$u(x, 0) = x+1, -1 < x < 1.$

SECTION-B

Q.No.4. (a) Highlight the difference between a vector and a tensor. What happens if we permute the subscripts of a tensor? (5)

(b) Transform $g^{ab} = \begin{pmatrix} 1 & 0 \\ 0 & 1/r^2 \end{pmatrix}$ into Cartesian coordinates. (15)

APPLIED MATHEMATICS, PAPER-II

- Q.No.5.** (a) Workout the Christoffel symbols for the metric tensor $g_{ab} = \begin{pmatrix} a^2 & 0 \\ 0 & a^2 \sin^2 \theta \end{pmatrix}$ (10)
- (b) Workout the two dimensional metric tensor for the coordinates p and q given by (10)
- $$p = (xy)^{\frac{1}{3}}, q = \left(\frac{x^2}{y}\right)^{\frac{1}{3}}$$

SECTION-C

- Q.No.6.** (a) Solve the following system of equations by Jacobi iteration method: (10)
- $$10x + y - 2z = 7.74$$
- $$x + 12y + 3z = 39.66$$
- $$3x + 4y + 15z = 54.8$$
- (b) Solve $\sin x = 1 + x^3$ Using Newton-Raphson method. (10)
- Q.No.7.** (a) Find the root of $xe^x = 3$ by regular falsi method correct to three decimal places. (10)
- (b) Evaluate $\int_0^{10} \frac{dx}{1+x^2}$ using (5+5) (10)
- (i) Trapezoidal rule and
- (ii) Simpson's rule.
- Q.No.8.** (a) Find the real root of the equation $\cos x = 3x - 1$ correct to seven decimal places by the iterative method. (10)
- (b) Use Lagrange's interpolation formula to find the value of y when $x = 10$, if the values of x and y are given below: (10)

X	5	6	9	11
Y	12	13	14	16
