FEDERAL PUBLIC SERVICE COMMISSION

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

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) $\dfrac{d^3 y}{dx^3} + \dfrac{dy}{dx} = Sec^2 x$ **(10)**

(b) $\dfrac{2dy}{dx} - \dfrac{x}{y} + x^3 Cos\ y = 0$ **(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 $Z(x+y)\dfrac{\partial Z}{\partial x} + Z(x-y)\dfrac{\partial Z}{\partial y} = (x^2 + y^2)$. **(10)**

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

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

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

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

$u(-1, t) = u(1, t); \dfrac{\partial u}{\partial x}(-1, t) = \dfrac{\partial u}{\partial x}(1, t)$ 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)**

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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)**

$$p = (xy)^{\frac{1}{3}}, \quad q = \left(\frac{x^2}{y}\right)^{\frac{1}{3}}$$

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 $Sinx = 1 + x^3$ 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 $\int_0^{10} \dfrac{dx}{1+x^2}$ using **(5+5)** **(10)**

(i) Trapezoidal rule and
(ii) Simpson's rule.

Q.No.8. **(a)** Find the real root of the equation $Cosx = 3x - 1$ 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

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