



# FEDERAL PUBLIC SERVICE COMMISSION

## COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2011

### APPLIED MATHEMATICS, PAPER-II

**TIME ALLOWED: THREE HOURS**

**MAXIMUM MARKS: 100**

**NOTE:** (i) Attempt **FIVE** questions in all by selecting **THREE** questions from **SECTION – A** and **TWO** questions from **SECTION – B**. All questions carry equal marks.  
(ii) **Use of Scientific Calculator is allowed.**  
(iii) **Extra attempt of any question or any part of the attempted question will not be considered.**

### SECTION - A

Q.1. (a) Solve by method of variation of parameter (10)

$$\frac{d^2 y}{dx^2} - 2 \frac{dy}{dx} + y = xe^x \ln x$$

(b) Solve first order non-linear differential equation (10)

$$x \frac{dy}{dx} + y = y^2 \ln x$$

Q.2. (a) Solve (10)

$$c^2 u_{xx} = u_{tt}.$$

$$u(0, t) = 0$$

$$u(l, t) = 0$$

$$u(x, 0) = \lambda \sin\left(\frac{\pi}{l} x\right)$$

$$u_t(x, 0) = 0$$

(b) Solve

$$x^2 \frac{\partial z}{\partial x} + y^2 \frac{\partial z}{\partial y} = (x + y)z \quad (10)$$

Q.3. (a) Work out the two dimensional metric tensor for the coordinates p and q given by (10)

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

(b) Prove that

$$\Gamma_{ab}^d = \frac{1}{2} g^{dc} \left( g_{ac,b} + g_{bc,a} - g_{ab,c} \right) \quad (10)$$

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Q.4. (a) Work out the Christoffel symbols for the following metric tensor

$$g_{ab} = \begin{pmatrix} 1 & 0 \\ 0 & r^2 \end{pmatrix}$$

(b) Work out the covariant derivative of the tensor with components

(10)

$$\begin{pmatrix} r \cos \theta & ar \sin \varphi & ar \\ \sin \theta \sin \varphi & a \sin \theta \cos \varphi & a \\ \cos \varphi & a \sin \varphi & 0 \end{pmatrix}$$

Q.5. (a) Find recurrence relations and power series solution of  $(x-3)y' + 2y = 0$

(10)

(b) Solve the Cauchy Euler's equation  $x^4 y''' + 2x^3 y'' - x^2 y' + xy = 1$

(10)

(10)

### SECTION – B

Q.6. (a) Find the positive solution of the following equation by Newton Raphson method

(10)

$$2 \sin x = x$$

(b) Solve the following system by Jacobi method:

(10)

$$10x_1 - 8x_2 = -6$$

$$-8x_1 + 10x_2 - x_3 = 9$$

$$-x_2 + 10x_3 = 28$$

Q.7. (a) Evaluate the following by using the trapezoidal rule.

(10)

$$\int_0^1 (x+1) dx$$

(b) Evaluate the following integral by using Simpson's rule

(10)

$$\int_0^4 e^x dx$$

Q.8. (a) Solve the following equation by regular falsi method:

(10)

$$2x^3 + x - 2 = 0$$

(b) Calculate the Lagrange interpolating polynomial using the following table:

(10)

|      |   |   |    |
|------|---|---|----|
| x    | 0 | 1 | 2  |
| f(x) | 1 | 0 | -1 |

also calculate f(0.5).

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