

**APPLIED MATH, PAPER-II**

**FEDERAL PUBLIC SERVICE COMMISSION  
COMPETITIVE EXAMINATION FOR  
RECRUITMENT TO POSTS IN BPS-17 UNDER  
THE FEDERAL GOVERNMENT, 2009**

**APPLIED MATH, PAPER-II**

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**TIME ALLOWED: 3 HOURS****MAXIMUM MARKS:100**

<b>NOTE:</b>	(i) Attempt <b>FIVE</b> question in all by selecting at least <b>TWO</b> questions from <b>SECTION-A</b> , <b>ONE</b> question from <b>SECTION-B</b> and <b>TWO</b> questions from <b>SECTION-C</b> . All questions carry <b>EQUAL</b> marks. (ii) <b>Use of Scientific Calculator is allowed.</b>
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**SECTION – A**

**Q.1. (a)** Using method of variation of parameters, find the general solution of the differential equation. (10)

$$y'' - 2y' + y = \frac{e^x}{x} . \quad (10)$$

(b) Find the recurrence formula for the power series solution around  $x=0$  for the differential equation

$$y'' + xy = e^{x+1} . \quad (10)$$

**Q.2. (a)** Find the solution of the problem (10)

$$u'' + 6u' + 9u = 0$$

$$u(0) = 2, \quad u'(0) = 0$$

(b) Find the integral curve of the equation

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

**Q.3. (a)** Using method of separation of variables, solve (10)

$$\frac{\partial^2 u}{\partial t^2} = 900 \frac{\partial^2 u}{\partial x^2} \quad \begin{cases} 0 < x < 2 \\ t > 0 \end{cases} ,$$

subject to the conditions

$$u(0, t) = u(2, t) = 0$$

$$u(x, 0) = 0 \quad \frac{\partial u}{\partial t} \Big|_{t=0} = 30 \sin 4\pi x .$$

(b) Find the solution of (10)

$$\frac{\partial^2 u}{\partial x^2} - 2 \frac{\partial^2 u}{\partial x \partial y} + \frac{\partial^2 u}{\partial y^2} = 4e^{3y} + \cos x .$$

**SECTION – B**

**Q.4. (a)** Define alternating symbol  $\epsilon_{ijk}$  and Kronecker delta  $\delta_{ij}$ . Also prove that (10)

$$\epsilon_{ijk} \epsilon_{lmk} = \delta_{il} \delta_{jm} - \delta_{im} \delta_{jl} .$$

(b) Using the tensor notation, prove that (10)

$$\nabla \times (\vec{A} \times \vec{B}) = \vec{A}(\nabla \cdot \vec{B}) - \vec{B}(\nabla \cdot \vec{A}) + (\vec{B} \cdot \nabla) \vec{A} - (\vec{A} \cdot \nabla) \vec{B}$$

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**Q.5. (a)** Show that the transformation matrix

$$\mathbf{T} = \begin{bmatrix} -\frac{1}{\sqrt{2}} & \frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{1}{2} & -\frac{1}{2} \end{bmatrix}$$

is orthogonal and right-handed.

(10)

(b) Prove that

(10)

$$l_{ik} l_{jk} = \delta_{ij}$$

where  $l_{ik}$  is the cosine of the angle between  $i$ th-axis of the system  $K'$  and  $j$ th-axis of the system  $K$ .

**SECTION – C**

**Q.6. (a)** Use Newton's method to find the solution accurate to within  $10^{-4}$  for the equation  $x^3 - 2x^2 - 5 = 0$ ,  $[1, 4]$ .

(10)

(b) Solve the following system of equations, using Gauss-Siedal iteration method

(10)

$$\begin{aligned} 4x_1 - x_2 + x_3 &= 8, \\ 2x_1 + 5x_2 + 2x_3 &= 3, \\ x_1 + 2x_2 + 4x_3 &= 11. \end{aligned}$$

**Q.7. (a)** Approximate the following integral, using Simpson's  $\frac{1}{3}$  rules

(10)

$$\int_0^1 x^2 e^{-x} dx.$$

(b) Approximate the following integral, using Trapezoidal rule

(10)

$$\int_0^{\pi/4} e^{3x} \sin 2x dx.$$

**Q.8. (a)** The polynomial

(10)

$$f(x) = 230x^4 + 18x^3 + 9x^2 - 221x - 9$$

has one real zero in  $[-1, 0]$ . Attempt approximate this zero to within  $10^{-6}$ , using the Regula Falsi method.

(b) Using Lagrange interpolation, approximate.

(10)

$$f(1.15), \text{ if } f(1) = 1.684370, f(1.1) = 1.949477, f(1.2) = 2.199796, f(1.3) = 2.439189, \\ f(1.4) = 2.670324$$

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