FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2015

Roll Number

APPLIED MATHEMATICS, PAPER-II

TIME ALLOWED: THREE HOURS	MAXIMUM MARKS: 100

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

SECTION-A

Q. No. 1. **(a)** Solve the initial value problem. **(10)**

$$\frac{dy}{dx}+\frac{y}{2x}=\frac{x}{y^3},\, y(1)=2$$

(b) Solve $y''-4y'+4y=e^{2x}$ **(10)**

Q. No. 2. Solve the following equations: **(10)**

(a) $(1-x^2)\frac{d^2y}{dx^2}-2x\frac{dy}{dx}+2y=0$

(b) $\frac{d^3y}{dx^3}+\frac{dy}{dx}=\cos ecx$ **(10)**

Q. No. 3. **(a)** Classify the following: **(5 each)** **(10)**

(i) $x^2U_{xx}+(a^2-y^2)U_{yy}=0 \quad , \quad -\infty<x<\infty,\ -a<y<a$

(ii) $U_{xx}-6U_{xy}+9U_{yy}+3y=0$

(b) Solve **(10)**

$$\frac{\partial^2 u}{\partial^2 t}=\frac{\partial^2 u}{\partial^2 x} \qquad 0<x<5$$
$$u(0,t)=u(5,t)=0$$
$$u(x,0)=x^2(x-5)$$
$$u_t(x,0)=0$$

SECTION-B

Q. No. 4. **(a)** Prove that if A_i and B_j are two first order tensors, then their product $A_iB_j\,(i,j=1,2,3)$ is a second order tensor. **(7)**

(b) If ¤(x_1,x_2,x_3) is a scalar point function then $\frac{\partial ¤}{\partial x_i}$ are the components of a first order tensor. **(7)**

(c) Find the invariant of the following second order tensor **(6)**

$$\begin{bmatrix} 2 & 4 & -1 \\ 6 & -7 & 10 \\ 3 & -4 & 6 \end{bmatrix}$$

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Q. No. 5. **(a)** Verify that the transformation **(7)**

$$x_1' = \frac{1}{15}(5x_1 - 14x_2 + 2x_3)$$

$$x_2' = -\frac{1}{3}(2x_1 + x_2 + 2x_3)$$

$$x_3' = \frac{1}{15}(10x_1 + 2x_2 - 11x_3)$$

Is orthogonal and right handed. A vector field $\vec{A}$ is defined in the system

$Ox_1x_2x_3$ by $A_1 = x_1^2, A_2 = x_2^2, A_3 = x_3^2$

Evaluate the components A_j' of the vector field in the new system $Ox_1'x_2'x_3'$.

(b) Prove that any second order tensor A_{ij} can be written as the sum of a deviator and an isotropic tensor. **(7)**

(c) If $a_{ij} = a_{ji}$ are constants. Calculate. **(6)**

$$\frac{\partial^2}{\partial X_k \partial X_m}(a_{ij} X_i X_j)$$

SECTION-C

Q. No. 6. **(a)** Find the real root of the equation by using Newton – Raphson's method. **(10)**

$$3x - \cos x - 1 = 0$$

(b) Solve the following system of equations by Gauss-Seidel method. Take initial approximation as $x_1 = 0,\ x_2 = 0,\ x_3 = 0$. Perform 3 Iterations. **(10)**

$$20x_1 + x_2 - 2x_3 = 17$$

$$3x_1 + 20x_2 - x_3 = -18$$

$$2x_1 - 3x_2 + 20x_3 = 25$$

Q. No. 7. **(a)** Find the real root of the equation $x^3 - 4x - 9 = 0$ by Regular falsi method. Take the interval of the root as (2,3) and perform 4 iterations. . **(10)**

(b) Find a polynomial which possess through the following points: **(10)**

x:	-1	0	1	2
$f(x)$:	2	1	2	5

Q. No. 8. **(a)** Use the langrage's Interpolation formula to find the value *f*(12) if the values of *x* and *f(x)* are given below **(10)**

x:	5	7	11	13
f(x)	150	392	1452	2366

(10)

(b) Evaluate $\int_0^3 x\sqrt{1+x^2}\,dx$ using $\frac{1}{3}$ Simpson's rule and trapezoidal rule for $n = 6$

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