FEDERAL PUBLIC SERVICE COMMISSION

COMPETITIVE EXAMINATION FOR RECRUITMENT TO POSTS IN BS-17 UNDER THE FEDERAL GOVERNMENT, 2012

Roll Number

APPLIED MATHS, PAPER-I

TIME ALLOWED:	**(PART-I MCQs)**	**30 MINUTES**	**MAXIMUM MARKS: 20**
THREE HOURS	**(PART-II)**	**2 HOURS & 30 MINUTES**	**MAXIMUM MARKS: 80**

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 **THREE** questions from **SECTION-A** and **TWO** questions from **SECTION-B.** All questions carry **EQUAL** marks.
(iii) Use of Scientific calculator is allowed.
(iv) Extra attempt of any question or any part of the attempted question will not be considered.

SECTION-A

Q.1. Explain the following: **(5 x 4=20)**

(a) Laplacian
(b) Simply and Multiply connected regions
(c) Directional derivatives
(d) Green's second Identity
(e) $\nabla \times (\nabla \times \vec{A}) = \nabla (\nabla . \vec{A}) - \nabla^2 \vec{A}$

Q.2. (a) State and prove Gauss Divergence theorem. **(10)**

(b) Evaluate, $\iint_S \vec{r}.\hat{n}\, dS$ **(10)**

Where S is the Surface of the ellipsoid?

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$$

Q.3. (a) Three forces *P, Q R* acting at a point are in equilibrium and the angle between *P* and *Q* is double of the angle between *P* and *R*. Prove that: **(10)**

$$R^2 = Q(Q-P)$$

(b) Find the distance from the cusp of the centroid of the region bounded by the cardioide. **(10)**

$$r = a(1+\cos\theta)$$

Q.4. (a) Find the centroid of the arc of the curve. **(10)**

$$x^{2/3}+y^{2/3}=a^{2/3}$$ Lying in the first quadrant.

(b) A uniform rod of weight *W* is placed with its lower end on a rough horizontal floor and its upper end against an equally rough vertical wall. The rod makes an angle α with the wall and is just prevented from slipping down by a horizontal force P applied at its middle point. **(10)**
Prove that,

$$P = W\tan(\alpha - 2\lambda);\quad \text{where } \lambda \text{ is the angle of friction and } \lambda < \frac{1}{2}\alpha$$

Q.5. (a) Six equal uniform rods freely jointed at their extremities form a tetrahedron. If this tetrahedron is placed with one face on a smooth horizontal table. Prove that the thrust along the horizontal rod is $\frac{w}{2\sqrt{6}}$. Where W=weight of the rod. **(10)**

(b) Write expression for arc length, area and volume elements in orthogonal curvilinear co-ordinates. **(10)**

SECTION-B

Q.6. (a) A particle is projected vertically upwards. After a time t, another particle is sent up from the same point with same velocity and meets the first at height h during the downward flight of the first. Find the velocity of projection. **(10)**

(b) What is simple harmonic motion? Discuss it in detail using derivatives with respect to time. **(10)**

Q.7. (a) Find the equation of trajectory of projectile with speed V_0 and angle of projection α. Also show that its path is parabolic. **(10)**

(b) Find the differential equation of orbit in polar coordinates. **(10)**

Q.8. (a) Explain Kepler's law. **(10)**

(b) Explain radial and transverse components of the acceleration of a particle moving along the circle $x^2 + y^2 = a^2$ with constant angular velocity c. **(10)**

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