LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **MATHEMATICS**

THIRD SEMESTER – **NOVEMBER 2024**

PMT3MC04 – FLUID DYNAMICS AND SPACE SCIENCE

Date: 14-11-2024 Dept. No. Max. : 100 Marks

Time: 01:00 pm-04:00 pm

	SECTION A – K1 (CO1)	
	Answer ALL the questions	**(5 x 1 = 5)**
1	**Answer the following**	
a)	What is the condition for irrotational motion of fluid flow?	
b)	Define zenith and nadir.	
c)	Why don't we get eclipses every month?	
d)	Define aberrations.	
e)	Write the cylindrical coordinates for equation of continuity.	
	SECTION A – K2 (CO1)	
	Answer ALL the questions	**(5 x 1 = 5)**
2	**MCQ**	
a)	In the velocity potential function $w=\phi+i\psi$, ψ denotes, i) Stream function ii) Velocity function iii) Streak function iv) Path function	
b)	The shortest point between earth and sun in its elliptic motion is known as _____ i) Apogee ii) Perigee iii) Aphelion iv) Perihelion	
c)	In the abbreviation of PSLV, P stands for _____ i) Polar ii) Polarization iii) Partial iv) Practical	
d)	The path traced by sun in its motion is called _____ i) Diurnal ii) Ecliptic iii) Circumpolar iv) Equatorial	
e)	The structure of Aerofoil was first designed by, i) Kutta ii) Bernoulli iii) Joukowski iv) Euler	
	SECTION B – K3 (CO2)	
	Answer any THREE of the following	**(3 x 10 = 30)**
3	The diameters of a pipe at the sections *A* and *B* are 200 *mm* and 300 *mm* respectively. If the velocity of water flowing through the pipe at section *A* is 4 *m/s*, find (i) discharge through the pipe (ii) velocity of water at section *B*.	

4	Derive the Bernoulli's equation of motion.

5	Explain in brief equinoxes and Solstices.
6	Derive Euler's equation of motion in spherical coordinates.
7	Test whether the motion specified by $q=\frac{k^2(x\vec{j}-y\vec{i})}{x^2+y^2}$ is a possible fluid motion and also find the streamlines, Test whether the motion is of the potential kind.
	SECTION C – K4 (CO3)
	Answer any TWO of the following **(2 x 12.5 = 25)**
8	Determine the displacement of a fluid particle in Lagrangian system for the velocity components $u=2x+2y+3t$ and $v=x+y+\frac{t}{2}$.
9	State and prove Kutta- Joukowski's theorem.
10	Identify and list the key factors of inter planetary trajectories.
11	Derive the equation of continuity by Euler's method in spherical form.
	SECTION D – K5 (CO4)
	Answer any ONE of the following **(1 x 15 = 15)**
12	Justify the following: (i) Why don't we feel the rotation of earth? (ii) Why all celestial bodies are almost spherical?
13	Examine the possibility of equation of motion for the incompressible, inviscid velocity components in spherical coordinates, $u_r=V\left(1-\frac{R^3}{r^3}\right)cos\theta$, $u_\theta=-V\left(1+\frac{R^3}{2r^3}\right)sin\theta$ and $u_\phi=0$.
	SECTION E – K6 (CO5)
	Answer any ONE of the following **(1 x 20 = 20)**
14	What arrangements of sources and sinks will give rise to the function $w=\log\left(z-\frac{a^2}{z}\right)$. Draw a rough sketch of the streamlines. Prove that two of the streamlines subdivide into the circle $r=a$ and axis of y.
15	Deduce Newton's law of gravitational motion from Kepler's law.

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