LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRD SEMESTER – **NOVEMBER 2023**

PMT3MC04 – FLUID DYNAMICS AND SPACE SCIENCE

Date: 07-11-2023   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)	Define zenith and nadir.	
b)	State the difference between Eulerian and Lagrangian fluid flow.	
c)	Why don't we get eclipses every month?	
d)	Define Source and Sink.	
e)	What are Aberrations?	

SECTION A – K2 (CO1)

	Answer ALL the questions	**(5 x 1 = 5)**
2	**Choose the correct answer**	
a)	With usual notations of fluid particles, which of these is velocity equation, i) $\vec{q} = -\nabla\phi$ ii) $\vec{q} = \nabla\phi$ iii) $|\vec{q}| = -\nabla\phi$ iv) None of these	
b)	The closest point between earth and sun in its elliptic motion is known as _____ i) Apogee ii) Perigee iii) Aphelion iv) Perihelion	
c)	The path traced by sun in its motion is called _____ i) diurnal ii) ecliptic iii) circumpolar iv) equatorial	
d)	The structure of Aerofoil was first designed by, i) Kutta ii) Bernoulli iii) Joukowski iv) Euler	
e)	For circulation about a circular cylinder the complex potential is given by i) $\left(ik/2\pi\right)\log z$ ii) $\left(2\pi/ik\right)\log z$ iii) $\left(2k/i\pi\right)\log z$ iv) $\left(2k/i\pi\right)\log z$	

SECTION B – K3 (CO2)

	Answer any THREE of the following	**(3 x 10 = 30)**
3	Construct the material, local and convective derivatives of a fluid particle.	
4	Derive the equation of continuity by Euler's method.	
5	The velocity components in a three-dimensional flow for an incompressible fluid are $(2x, -y, -z)$. Is it a possible field? Determine the equation of the streamline passing through the point $(1,1,1)$. Sketch the streamlines.	
6	Explain in brief equinoxes and Solstices.	
7	Identify and list the key factors of inter planetary trajectories.	

SECTION C – K4 (CO3)

Answer any TWO of the following **(2 x 12.5 = 25)**

8	Analyze the durations of day and night in Chennai by equinoxes and solstices.
9	Deduce the Euler's equation of motion in cartesian form.
10	Brief on the six orbital elements of rocket motion.
11	Derive the expression for rocket propulsion.

SECTION D – K5 (CO4)

Answer any ONE of the following **(1 x 15 = 15)**

12	Determine the displacement of a fluid particle in Lagrangian system for the velocity components $u = 2x + 2y + 3t$ and $v = x + y + \frac{t}{2}$.
13	Discuss the various components of rocket.

SECTION E – K6 (CO5)

Answer any ONE of the following **(1 x 20 = 20)**

14	Deduce Newton's law of gravitational motion from Kepler's law.
15	Examine the possibility of equation of motion for the incompressible, inviscid velocity components in spherical coordinates, $$u_r = V\left(1 - \frac{R^3}{r^3}\right)\cos\theta\ ,\ u_\theta = -V\left(1 + \frac{R^3}{2r^3}\right)\sin\theta \text{ and } u_\phi = 0.$$

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