Exam Date & Time: 29-Sep-2020 (02:00 PM - 05:45 PM)

PSG COLLEGE OF ARTS AND SCIENCE

Note: Writing 3hrs: Checking & Inserting Image : 30mins

MSc DEGREE EXAMINATION MAY 2020
(Fourth Semester)

Branch - MATHEMATICS

FLUID DYNAMICS [18MAP16]

Marks: 75 **Duration: 210 mins.**

SECTION A

Answer all the questions.

1) The thermal conductivity in fourier heat conduction law is _____

(i) $\frac{J}{Ms\,deg\,K}$ (ii) $\frac{1}{Mjdeg\,K}$ (iii) $\frac{w}{deg\,K}$ (iv) $\frac{J}{deg\,K}$ (1)

2) The equation of streamline is _____.

(i) $qxd\tau=1$ (ii) $qxd\tau=-1$ (iii) $qxd\tau=0$ (iv) $qxd\tau=c$ (1)

3) _____ is expressed in terms of the change in angle between two linear elements from the unstrained state to the strained state.

(i) strain (ii) normal strain (iii) direct strain (iv) shearing strain (1)

4) In compressible fluid, the equation of continuity is

(i) $\frac{D\rho}{Dt}+\nabla.q=0$ (ii) $\frac{D\rho}{Dt}+\rho\nabla.q=0$

(iii) $\frac{D\rho}{Dt}-\nabla.q=0$ (iv) $\frac{D\rho}{Dt}-\rho\nabla.q=0$ (1)

5) The necessary condition of a velocity potential in a fluid of irrotantional motion is

(i) $\nabla.q=0$ (ii) $\nabla.q=1$ (iii) $\nabla xq=1$ (iv) $\nabla xq=0$ (1)

6) A sink is represented algebraically as _____ of source.

(i) positive (ii) negative (iii) both (i) and (ii) (iv) neither (i) nor (ii) (1)

7) Reynolds number of flow is _____

(i) $\frac{q\propto l}{\gamma}$ (ii) $\frac{q\propto}{\gamma}$ (iii) $\frac{q\propto}{l}$ (iv) $q\propto l$ (1)

8) _____ is the flow between two parallel plates are both stationery. (1)

(i) coquette flow (ii) plane poiseville flow
(iii) Hagen poiseville flow (iv) both (i) and (ii)

9) Vorticity transport equation states as _____ (1)

(i) $\frac{D\Omega}{Dt} - (\Omega\nabla)q = 0$ (ii) $\frac{D\Omega}{Dt} - (\Omega\nabla)q = \gamma\nabla^2\Omega$

(iii) $\frac{D\Omega}{Dt} - (\Omega\nabla)q = \gamma$ (iv) $\frac{D\Omega}{Dt} + (\Omega\nabla)q = \gamma\nabla^2\Omega$

10) In momentum integral equation, _____ method is that the solutions satisfy the differential equations only on the average. (1)

(i) Von Karman method (ii) Howarth method
(iii) Ni Kuradse method (iv) Prandth method

SECTION B

Answer all the questions.

11) State the fluid properties of thermal conductivity. (5)

a)

[OR]

b) Determine the equation of the streamlines if the velocity vector q is given by q=ix-jy. (5)

12) Verify the equality of shearing stresses $\sigma_{yz}=\sigma_{zy}$, $\sigma_{xz}=\sigma_{zx}$ and $\sigma_{xy}=\sigma_{yx}$. (5)

a)

[OR]

b) Is the equation of continuity satisfied in the following incompressible steady flow field velocities as $u(x,y) = \frac{K(x^2-y^2)}{(x^2+y^2)^2}$, $v(x,y) = \frac{2Kxy}{(x^2+y^2)^2}$. (5)

13) State and prove Kelvin's theorem of circulation. (5)

a)

[OR]

b) Show that the velocity potential $Q = \frac{a}{2}(x^2+y^2-2z^2)$ satisfies the Laplace equation and represent the flow against a fixed plane wall. (5)

14) Express the significant role of Reynolds number in similarity of flows. (5)

a)

[OR]

b) Determine the maximum value of the velocity profile in the annular space between two coaxial cylinders. (5)

15) Calculate average skin friction of shearing stress. (5)

a)

[OR]

b) Derive Van Karman Integral relation of boundary layer. (5)

SECTION C

Answer all the questions.

16) Solve vorticity in polar coordinates. Also determine the equation of vortex lines if the velocity vector in the fluid field q=i(az-By)+j(Bx-Cz)+K(Cy-Ax). (8)

a)

[OR]

b) Calculate material derivative and acceleration of a fluid particle in Cartesian, cylindrical and spherical coordinates. (8)

17) Calculate the rate of strains in fluid dynamics. (8)

a)

[OR]

b) Derive energy equation. (8)

18) Derive momentum theorem. (8)

a)

[OR]

b) Derive Laplace's equation in spherical coordinates. (8)

19) Calculate (i) maximum and average velocity
(ii) shearing stress of plane poiseuille flow. (8)

a)

[OR]

b) Find the rate of flow between two concentric rotating cylinders. (8)

20) Derive Blasius solution. (8)

a)

[OR]

b) Solve boundary layer equation on a surface with pressure gradient. (8)

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