Roll. No. ....

O.M.R. Serial No.

Question Booklet Number

M.A./M.Sc. (SEM.-IV)(NEP) (SUPPLE.) EXAMINATION, 2024-25

MATHEMATICS

(Advanced Fluid Mechanics)

Paper Code							
B	0	3	1	0	0	3	T

Question Booklet Series

A

Time : 1 : 30 Hours **Max. Marks : 75**

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.
4. Four alternative answers are mentioned for each question as - A, B, C & D in the booklet. The candidate has to choose the correct / answer and mark the same in the OMR Answer-Sheet as per the direction :

(Remaining instructions on last page)

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, उसे तुरन्त बदल लें।
4. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर- A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से सही उत्तर छाँटना है। उत्तर को OMR उत्तर-पत्रक में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

(शेष निर्देश अन्तिम पृष्ठ पर)

1. The complex potential due to vortex doublet of strength μ kept at the origin with its axis inclined at angle α is given by :

(A) $\frac{\mu e^{i\alpha}}{z}$

(B) $\frac{\mu e^{-i\alpha}}{z}$

(C) $\frac{-\mu e^{i\alpha}}{z}$

(D) $\frac{-\mu e^{-i\alpha}}{z}$

2. The image of vortex +k outside a circular boundary is :

(A) A vortex +k at the inverse point and vortex -k at the centre

(B) A vortex -k at the inverse point and vortex +k at the centre

(C) A vortex +k at the inverse point and the centre

(D) None of the above

3. At an internal point in a fluid, vortex lines :

(A) Can originate

(B) Can terminate

(C) Can not originate

(D) None of the above

4. The concept of a vortex doublet is most commonly used :

(A) Quantum Mechanics

(B) Fluid dynamics

(C) Electromagnatism

(D) Thermodynamics

5. In the complex potential function $W(z)=\frac{-k}{(z-z_o)^2}$ what does z_o represent?

(A) The strength of the vortex doublet

(B) The location of the vortex doublet

(C) The radius of the vortex doublet

(D) None of the above

6. In usual symbols if $(u,v,w)=\mu\left(\frac{\partial\phi}{\partial x},\frac{\partial\phi}{\partial y},\frac{\partial\phi}{\partial z}\right)$, then angle θ between the vortex lines and stream lines is :

(A) 0°

(B) 45°

(C) 90°

(D) None of the above

7. The flow pattern observed at the centre of a vortex is :

(A) Uniform flow

(B) Radial flow

(C) Zero flow

(D) Tangential flow

8. In three-dimensional motion of fluid, the component of rotation about z-axis is given by :

(A) $\frac{1}{2}\left(\frac{\partial u}{\partial z}-\frac{\partial w}{\partial x}\right)$

(B) $\frac{1}{2}\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)$

(C) $\frac{1}{2}\left(\frac{\partial w}{\partial y}-\frac{\partial v}{\partial z}\right)$

(D) $\frac{1}{2}\left(\frac{\partial v}{\partial y}-\frac{\partial v}{\partial x}\right)$

9. The flow of fluid along curvilinear or curved path is known as :

(A) Curvilinear flow

(B) Circular flow

(C) Sink flow

(D) Vortex flow

10. A thin stream of incompressible fluid is contained between two concentric spheres. If the fluid be homogeneous and the motion irrotational then :

(A) $W = F\left[e^{iw} \tan\theta\right]$

(B) $W = F\left[e^{-iw} \tan\theta\right]$

(C) $W = F\left[e^{iw} \tan\frac{\theta}{2}\right]$

(D) $W = F\left[e^{-iw} \tan\frac{\theta}{2}\right]$

11. The complex potential due to a spiral vortex is given by :

(A) $\left(\frac{ik}{2\pi} - m\right)\log z$

(B) $\left(\frac{ik}{2\pi} + m\right)\log z$

(C) $\left(\frac{ik}{\pi} - m\right)\log z$

(D) $\left(\frac{ik}{\pi} + m\right)\log z$

12. A solid sphere moves through quiescent frictionless liquid whose boundaries are at a distance from it, great compared with its radius. Then liquid streams past the sides of sphere with :

(A) Velocity of sphere

(B) $\frac{1}{2}$ Velocity of sphere

(C) $\frac{1}{3}$ Velocity of sphere

(D) None of the above

13. For motion of a sphere through an infinite mass of liquid at rest at infinity, velocity potential ϕ is given by :

(A) $\frac{ua^3 \cos\theta}{2r}$

(B) $\frac{ua^3 \cos\theta}{2r^2}$

(C) $\frac{ua^3 \cos\theta}{2r^3}$

(D) None of the above

14. In a three dimensional irrotational flow, the velocity potential satisfies which equation :

(A) Navier-Stoke's equation

(B) Euler's equation

(C) Laplace's equation

(D) Continuity equation

15. If ϕ be the velocity potential due to a simple three-dimensional source, then in usual symbol :

(A) $\phi = \frac{m}{r}$

(B) $\phi = \frac{-m}{r}$

(C) $\phi = \frac{m}{r^2}$

(D) $\phi = \frac{-m}{r^2}$

16. The equation of lines of flow relative to a sphere is :

(A) $\text{Sin}^2\theta = \frac{r^3 - a^3}{cr}$

(B) $\text{Sin}^2\theta = \frac{r^2 + a^3}{cr}$

(C) $\text{Sin}^2\theta = \frac{cr}{r^3 + a^3}$

(D) $\text{Sin}^2\theta = \frac{cr}{r^3 - a^3}$

17. A columnar vortex filament moves in an infinite liquid bounded by two plane walls intersecting at right angles and parallel to the vortex. Then the path of any point of the vortex has equation :

(A) $r \sin 2\theta = \text{const}\cdot$

(B) $r \sin \theta = \text{const}\cdot$

(C) $r \cos 2\theta = \text{const}\cdot$

(D) $r \cos \theta = \text{const}\cdot$

18. The Stoke's stream function applies to the :

(A) Irrotational flow only

(B) Ideal fluid only

(C) Cases of axial symmetry

(D) None of the above

19. For a simple source of strength m at the origin, the value of Stoke's stream function at the point $P(r,\theta,\phi)$ is :

(A) $m\sin\theta$ (B) $m\cos\theta$

(C) $m\sin 2\theta$ (D) $m\cos 2\theta$

20. If the velocity potential is given by $\phi = x^2 - y^2 + z^2$, what is the velocity field?

(A) $2x\hat{i} - 2y\hat{j} + 2z\hat{k}$

(B) $-2x\hat{i} + 2y\hat{j} - 2z\hat{k}$

(C) $x\hat{i} - y\hat{j} + z\hat{k}$

(D) $-x\hat{i} + y\hat{j} - z\hat{k}$

21. According to Newton's law of viscosity, the maximum velocity flow is at :

(A) Top of the tube

(B) Bottom of the tube

(C) Middle of the tube

(D) It is same at all the places

22. The factor on which viscosity depends :

(A) Area of contact of two adjacent layers

(B) Velocity difference between two adjacent laters

(C) The distance between two adjacent layers

(D) All of the mentioned

23. The viscosity of a fluid is inversely proportional to the :

(A) Area of contact of two adjacent layers

(B) Distance between two adjacent layers

(C) Velocity difference between two adjacent layers

(D) None of the above

24. The Newton's law of viscosity is not applicable to :

(A) Turbulent flow

(B) Laminar flow

(C) Stream line flow

(D) All of the above

25. Which of the following statement is correct about the shear stress distribution?

(A) It is linear with maximum value at the centre

(B) It is parabolic with maximum value at the centre

(C) It is parabolic with zero value at the centre

(D) It is linear with zero value at the centre

26. When a fluid is in motion, the pressure at a point is the same in all directions. Then the fluid is :

(A) Real fluid

(B) Newtonian fluid

(C) Ideal fluid

(D) Non-Newtonian fluid

27. Elastic limit is the point :
(A) Up to which stress is proportinal to strain
(B) At which elongation takes place without application of additional load
(C) Up to which if the load is removed, original volume and shapes are regained
(D) None of the above

28. What is the stress-strain curve?
(A) It is the percentage of stress and strain
(B) It is relationship between stress and strain
(C) It is the difference between stress and strain
(D) None of the above

29. The Navier-Stokes equations are _______ system of equations.
(A) Coupled
(B) Uncoupled
(C) Exponential
(D) Radical

30. The major difference between the Navier-Stokes equation and the Euler equations is the dissipative transport phenomena. The impact of this phenomena in a system is :
(A) They decrease entropy
(B) They increase entropy
(C) They increase internal energy
(D) They decrease internal energy

31. The components $\tau_{xx}, \tau_{yy}, \tau_{zz}$ of the stress are called :
(A) Normal stress
(B) Shear stress
(C) Complex stress
(D) None of the above

32. The components $\tau_{xy}, \tau_{yz}, \tau_{xz}$ of the stress are called :
(A) Normal stress
(B) Shear stress
(C) Complex stress
(D) None of the above

33. If the stress matrix at a point P is given by $\begin{pmatrix} 2 & 1 & -3 \\ 1 & 1 & 2 \\ -3 & 2 & 1 \end{pmatrix}$ then stress vector on the plane passing through P and parallel to the plane whose unit normal is $\frac{3}{7}\hat{i} + \frac{6}{7}\hat{j} + \frac{2}{7}\hat{k}$ is :
(A) $\frac{6}{7}\hat{i} + \frac{13}{7}\hat{j} + \frac{5}{7}\hat{k}$
(B) $\frac{13}{7}\hat{i} + \frac{6}{7}\hat{j} + \frac{5}{7}\hat{k}$
(C) $\frac{5}{7}\hat{i} + \frac{6}{7}\hat{j} + \frac{13}{7}\hat{k}$
(D) None of the above

34. If the stress tensor is given by $\tau_{ij} = \begin{pmatrix} 6 & 2 & 0 \\ 2 & 3 & 0 \\ 0 & 0 & 4 \end{pmatrix}$,then principal stress values are :
(A) 2, 7, 4 (B) 3, 2, 4
(C) 4, 3, 7
(D) None of the above

35. If the stress tensor at a point is given by $\tau_{ij} = \begin{pmatrix} 3 & 1 & 1 \\ 1 & 0 & 2 \\ 1 & 2 & 0 \end{pmatrix}$, then principal stress values are :
(A) -2, 1, 4 (B) 2, 1, 4
(C) 2, -1, 4
(D) None of the above

36. If stress tensor at a point P is given by $\begin{pmatrix} 7 & 0 & -2 \\ 0 & 5 & 0 \\ -2 & 0 & 4 \end{pmatrix}$, then the stress vector on the plane at P whose unit normal is $n = \frac{2}{3}\hat{i} - \frac{2}{3}\hat{j} + \frac{1}{3}\hat{k}$ is :

(A) $4\hat{i} + \frac{10}{3}\hat{j}$

(B) $4\hat{i} - \frac{10}{3}\hat{j}$

(C) $-4\hat{i} + \frac{10}{3}\hat{j}$

(D) None of the above

37. For the stress tensor $\begin{pmatrix} 6 & -3 & 0 \\ -3 & 6 & 0 \\ 0 & 0 & 8 \end{pmatrix}$ the invariants I_1, I_2, I_3 are :

(A) 20, 123, 216

(B) 20, 143, 216

(C) 25, 123, 216

(D) None of the above

38. For an ideal fluid :

(A) $\tau_{xy} = 0$

(B) $\tau_{yz} = 0$

(C) $\tau_{xz} = 0$

(D) All of the above

39. Rate of strain is :

(A) Tensor of order 1

(B) Tensor of order 2

(C) Tensor of order 3

(D) None of the above

40. Consider a rectangular flow $q = \{0, 0, \phi(x_1, x_2)\}$ of an isotropic incompressible fluid. Then which of the following is true?

(A) $\varepsilon_{13} = \frac{1}{2}\frac{\partial\phi}{\partial x_1}, \varepsilon_{23} = \frac{1}{2}\frac{\partial\phi}{\partial x_2}$

(B) $\varepsilon_{13} = 2\frac{\partial\phi}{\partial x_1}, \varepsilon_{23} = \frac{1}{2}\frac{\partial\phi}{\partial x_2}$

(C) $\varepsilon_{13} = \frac{1}{2}\frac{\partial\phi}{\partial x_1}, \varepsilon_{23} = 2\frac{\partial\phi}{\partial x_2}$

(D) None of the above

41. Strain components $\varepsilon_{xx}, \varepsilon_{yy}, \varepsilon_{zz}$ are called:

(A) Normal strain

(B) Shearing strain

(C) Complex strain

(D) None of the above

42. Strain components $\varepsilon_{xy}, \varepsilon_{yz}, \varepsilon_{xz}$ are called:

(A) Normal strain

(B) Shearing strain

(C) Complex strain

(D) None of the above

43. If u = cx, v = cy, w = -2cz, then which of the following is true?

(A) $\varepsilon_{xx} = c \quad , \varepsilon_{yy} = c \quad , \varepsilon_{zz} = -2c$

(B) $\varepsilon_{xy} = 0 \quad , \varepsilon_{yz} = 0 \quad , \varepsilon_{xz} = 0$

(C) Both (A) and (B)

(D) None of the above

44. Diffusion terms are not included in _____ of the Navier-Stokes equations.

(A) Continuity equation

(B) Y-momentum equation

(C) Z-momentum equation

(D) Energy equation

45. When is the fluid called laminar?
(A) Low viscosity
(B) The density of the fluid is high
(C) Reynolds number is greater than 2000
(D) Reynolds number is less than 2000

46. Which of the following relation is stated by Hooke's law?
(A) Stress is directly proportional to strain
(B) Stress is inversely proportional to strain
(C) Stress is directly proportional to square of strain
(D) Stress is inversely proportional to square of strain

47. The Navier-Stokes equation can be used in which of the following applications?
(A) Automobiles
(B) Ocean Currents
(C) Air planes
(D) Thermometer

48. What is the incompressibility condition in Naver-Stokes equation?
(A) $\nabla.q = 0$ (B) $\nabla.q > 0$
(C) $\nabla.q < 0$ (D) $\nabla.q = 1$

49. At low Reynolds number :
(A) Viscous forces are unimportant
(B) Viscous forces control and inertial forces are unimportant
(C) Gravity forces control
(D) None of the above

50. At high Reynolds number :
(A) Inertial forces control and viscous forces are unimportant
(B) Inertial forces are unimportant and viscous forces control
(C) Viscous forces predominate
(D) None of the above

51. The Stoke's stream function for a simple source on axis of x, in usual notation is given by :
(A) $m \sin\theta$ (B) mx
(C) $\frac{mx}{r}$ (D) $\frac{mx}{r^2}$

52. If ϕ be the velocity potential due to a three-dimensional doublet, then in usual symbol:
(A) $\phi = \frac{\mu}{r^2}\cos\theta$
(B) $\phi = \frac{\mu}{r^3}\cos\theta$
(C) $\phi = \frac{\mu}{r}\cos\theta$
(D) None of the above

53. The velocity potential exist only where the motion is :
(A) Rotational
(B) Steady
(C) Irrotational
(D) None of the above

54. Fluids that obey Newton's law of _____ are called Newtonian fluids.
(A) Compressibility
(B) Elasticity
(C) Viscosity
(D) None of the above

55. Perfect fluids are also known as :

(A) Inviscid fluids

(B) Viscid fluids

(C) Newtonian fluids

(D) None of the above

56. The motion of a fluid is said to be irrotational, if the value of the ____ vector is zero.

(A) Vorticity (B) Normal

(C) Unit

(D) None of the above

57. The complex potential for a doublet of strength μ kept at the origin z = 0 with its axis inclined at an angle α with real axis is:

(A) $\frac{\mu_e i\alpha}{z}$ (B) $\frac{\mu_e - id}{z}$

(C) $\frac{-\mu_e i\alpha}{z}$ (D) $\frac{-\mu_e - id}{z}$

58. Image of a doublet of strength μ w.r.t. a sphere is :

(A) A doublet of strength $\frac{\mu a^2}{f^2}$ at the inverse point

(B) A doublet of strength $\frac{\mu a^2}{f^3}$ at the inverse point

(C) A doublet of strength $\frac{\mu a^3}{f^3}$ at the inverse point

(D) None of the above

59. The complex potential due to a vortex of strength k at $z = z_0$ is given by :

(A) $W = \frac{ik}{2\pi}\log(z - z_0)$

(B) $W = \frac{ik}{\pi}\log(z - z_0)$

(C) $W = -\frac{ik}{2\pi}\log(z - z_0)$

(D) None of the above

60. How does the complex potential W(z) for a vortex doublet relate to the stream function?

(A) The stream function is real part of complex potential

(B) The stream function is the imaginary part of the complex potential

(C) The stream function is unrelated to complex potential

(D) None of the above

61. If $u = \frac{ax - by}{x^2 + y^2}, v = \frac{ay + bx}{x^2 + y^2}, \quad w = 0,$ then the velocity potential is :

(A) $\frac{a}{2}\log(x^2 + y^2) + b\tan^{-1}\left(\frac{y}{x}\right)$

(B) $-\left\{\frac{a}{2}\log(x^2 + y^2) + b\tan^{-1}\left(\frac{y}{x}\right)\right\}$

(C) $\frac{a}{2}\log(x^2 + y^2) - b\tan^{-1}\left(\frac{y}{x}\right)$

(D) None of the above

62. The motion due to a set of line vortices of strength k at points $z = \pm na(n = 0, 1, 2, --)$ is given by the relation :

(A) $W = \frac{ik}{2\pi}\log\sin\frac{\pi z}{a}$

(B) $W = \frac{ik}{\pi}\log\sin\frac{\pi z}{a}$

(C) $W = \frac{k}{2\pi}\log\sin\frac{\pi z}{a}$

(D) None of the above

63. An infinite liquid contains two parallel equal and opposite rectilinear vortex filaments at distance 2b. Then the paths of the fluid particles relative to the vortices can be represented by :

(A) $\log\left[\frac{r^2+b^2-2br\cos\theta}{r^2+b^2+2br\cos\theta}\right]-\frac{r\cos\theta}{b}=\text{const.}$

(B) $\log\left[\frac{r^2+b^2-2br\sin\theta}{r^2+b^2+2br\sin\theta}\right]+\frac{r\cos\theta}{b}=\text{const.}$

(C) $\log\left[\frac{r^2+b^2-2br\cos\theta}{r^2+b^2+2br\cos\theta}\right]+\frac{r\cos\theta}{b}=\text{const.}$

(D) None of the above

64. An infinite liquid contains two parallel equal and opposite vortices at a distance 2b, then streamlines relative to the vortices are given by :

(A) $\log\left[\frac{x^2+(y-b)^2}{x^2+(y+b)^2}\right]+\frac{y}{b}=c$

(B) $\log\left[\frac{(x-b)^2+y^2}{(x+b)^2+y^2}\right]+\frac{y}{b}=c$

(C) $\log\left[\frac{x^2+(y-b)^2}{x^2+(y+b)^2}\right]\frac{y}{b}=c$

(D) None of the above

65. If $u=\frac{ax-by}{x^2+y^2},\quad v=\frac{ay+bx}{x^2+y^2}, w=0,$ then the liquid motion is :

(A) Rotational

(B) Irrotational

(C) Conditional

(D) None of the above

66. Two point vortices each of strength k are situated at $(\neq a, 0)$ and a point vortex of strength $\frac{-k}{2}$ is situated at the origin. Then equation of streamlines are given by :

(A) $(x^2+y^2)^2+2a^2(x^2-y^2)+a^4=c(x^2+y^2)\frac{1}{2}$

(B) $(x^2+y^2)^2-2a^2(x^2-y^2)+a^4=c(x^2+y^2)\frac{1}{2}$

(C) $(x^2+y^2)-2a^2(x^2+y^2)+a^4=c(x^2+y^2)\frac{1}{2}$

(D) None of the above

67. A vortex in an infinite liquid occupying the upper half of the z-plane bounded by a circle of radius a, centre o and parts of x-axis outside the circle. Then the path of the vortex is :

(A) $(x^2+y^2-a^2)^2+4a^2y^2=cy^2(x^2+y^2-a^2)^2$

(B) $(x^2+y^2-a^2)^2+4a^2y^2=cx^2(x^2+y^2-a^2)^2$

(C) $(x^2+y^2-a^2)-4a^2y^2=cy^2(x^2+y^2-a^2)^2$

(D) None of the above

68. A doublet of strength m is placed at point (0, a, 0) with its axis parallel to the axis of z, the velocity potential of doublet at points close to origin is :

(A) $\phi=\frac{mz}{a^2}+\frac{3myz}{a^3}$

(B) $\phi=\frac{mz}{a^3}+\frac{3myz}{a^4}$

(C) $\phi=\frac{mz}{a^4}+\frac{3myz}{a^3}$

(D) None of the above

69. If $u = \frac{ax - by}{x^2 + y^2}, v = \frac{ay + bx}{x^2 + y^2}, w = 0$ then pressure at any point (x,y) is given by :

(A) $\frac{P}{\rho} = \text{const.} - \frac{1}{2}\left(\frac{a^2 + b^2}{x^2 + y^2}\right)$

(B) $\frac{P}{\rho} = \text{const.} - \frac{1}{2}\left(\frac{a^2 - b^2}{x^2 + y^2}\right)$

(C) $\frac{P}{\rho} = \text{const.} - \frac{1}{2}\left(\frac{a^2 + b^2}{x^2 - y^2}\right)$

(D) None of the above

70. The necessary and sufficient condition that vortex lines are at right angles to the streamlines is :

(A) $U\left(\frac{\partial w}{\partial y} - \frac{\partial v}{\partial z}\right) + v\left(\frac{\partial v}{\partial z} - \frac{\partial w}{\partial x}\right) + w\left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right) = 0$

(B) $U\left(\frac{\partial w}{\partial y} + \frac{\partial v}{\partial z}\right) + u\left(\frac{\partial v}{\partial z} + \frac{\partial w}{\partial x}\right) + w\left(\frac{\partial v}{\partial x} + \frac{\partial u}{\partial y}\right) = 0$

(C) $U\left(\frac{\partial w}{\partial y} - \frac{\partial v}{\partial z}\right) + v\left(\frac{\partial v}{\partial z} - \frac{\partial w}{\partial x}\right) + w\left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right) = 1$

(D) None of the above

71. If the velocity field defined at a point by $u = ax + by - cz, v = d - bx + ez, w = f + cx - ey$ where a, b, c, d, e, f are arbitrary constants. Then it represents :

(A) Rigid body stay

(B) Rigid body rotation

(C) Rigid body flow

(D) None of the above

72. If the stress tensor at a point is given by

$$\tau_{ij} = \begin{pmatrix} 3 & 1 & 1 \\ 1 & 0 & 2 \\ 1 & 2 & 0 \end{pmatrix}$$

, then direction cosines of the principal stress $\tau_{1=-2}$ are :

(A) $\left(0, \frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right)$

(B) $\left(0, \frac{-1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$

(C) $\left(\frac{1}{\sqrt{2}}, 0, \frac{-1}{\sqrt{2}}\right)$

(D) None of the above

73. If the stress tensor at a point is given by

$$\begin{pmatrix} 7 & -5 & 0 \\ -5 & 3 & 1 \\ 0 & 1 & 2 \end{pmatrix}$$

. Then the stress vector on the plane passing through the point P and Moving for its equation $\frac{x}{4} + \frac{y}{2} + \frac{z}{6} = 1$:

(A) $-\frac{9}{7}\hat{i} - \frac{5}{7}\hat{j} + \frac{10}{7}\hat{k}$

(B) $\frac{9}{7}\hat{i} + \frac{5}{7}\hat{j} + \frac{10}{7}\hat{k}$

(C) $-\frac{9}{7}\hat{i} + \frac{5}{7}\hat{j} + \frac{10}{7}\hat{k}$

(D) None of the above

74. Water at $70^{\circ}F$ flow between two parallel plates one of which is at rest and the other moving with a velocity U. If the volumetric flow per unit width is zero, then which of the following is true?

(A) $\frac{dp}{dx} = \frac{6\mu u}{h^3}$

(B) $\frac{dp}{dx} = \frac{6\mu u}{h^2}$

(C) $\frac{dp}{dx} = \frac{3\mu u}{h^2}$

(D) None of the above

75. The space between two co-axial cylinders fo radii a and b is filled with viscous fluid and the cylinders are made to rotate with angular velocities w_1, w_2 .Then angular velocity w of fluid is :

(A) $\dfrac{a^2\left(b^2-r^2\right)w_1-b^2\left(r^2-a^2\right)w_2}{r^2\left(b^2-a^2\right)}$

(B) $\dfrac{a^2\left(b^2-r^2\right)+b^2\left(r^2-a^2\right)w_2}{r^2\left(b^2-a^2\right)}$

(C) $\dfrac{a^2\left(b^2+r^2\right)w_1+b^2\left(r^2+a^2\right)w_2}{r^2\left(b^2+a^2\right)}$

(D) None of the above

76. Navier-Stoke's equation for viscous in compressible fluid is :

(A) $\dfrac{dq}{dt}=F-\dfrac{1}{\rho}\nabla P-\nu\nabla^2 q$

(B) $\dfrac{dq}{dt}=F+\dfrac{1}{\rho}\nabla P+\nu\nabla^2 q$

(C) $\dfrac{dq}{dt}=F-\dfrac{1}{\rho}\nabla P+\nu\nabla^2 q$

(D) None of the above

77. Oil is filled between two concentric rotating cylinders with radii 5 inch and $\frac{11}{2}$ inch. Assume that $\mu = 0.005$ lbf sec/ft^2. The inner cylinder rotates at a speed of 5 rpm, while the outer cylinder is at rest. Then stress at the wall of the cylinder is :

(A) $-0.048 \text{ lbf / ft}^2$

(B) $-0.0048 \text{ lbf / ft}^2$

(C) -0.48 lbf / ft^2

(D) None of the above

78. Water at $20^\circ C$ flows between two large parallel plates at a distance 1.5 mm apart. If the average velocity is 0.15 m/sec, then maximum velocity is :

(A) 0.252 m/s (B) 0.225 m/s

(C) 0.215 m/s

(D) None of the above

79. Water at $20^\circ C$ flows between two large parallel plates at a distance 1.5 mm apart. If the average velocity is 0.15 m/sec, $\mu = 1.01 g / m\sec$, then pressure drop is :

(A) $-808 N / m^3$

(B) $-880 N / m^3$

(C) $800 N / m^3$

(D) None of the above

80. Water at $20^\circ C$ flows between two large parallel plates at a distance 1.5 mm apart. If the velocity is 0.15 m/sec, $\mu = 1.01 g / m\sec$, then the frictional coefficient is :

(A) 0.0538 (B) 0.538

(C) 0.0583 (D) 0.583

81. For an ideal fluid which of the following is true?

(A) $\tau_{xy} = 0$ (B) $\tau_{yz} = 0$

(C) $\tau_{xz} = 0$

(D) All of the above

82. What are the independent variables in the Navier Stokes equations?

(A) x, y, z, ρ

(B) x, y, z, P

(C) x, y, z, t, ρ

(D) x, y, z, t

83. What are the dependent variables in the Navier-Stokes equations?
(A) T, p, ρ
(B) u, v, w, T, p, ρ
(C) u, v, w, T, ρ
(D) u, v, w, ρ

84. The Navier-Stokes equations are all partial differential equations. What will be the best reason behind this?
(A) Ordinary differentials are not present in the Navier-Stoke's equations
(B) Each dependent variables are functions of all of the independent variables
(C) Each dependent variables depends on only one of the independent variables
(D) None of the above

85. The Reynolds number for an ideal fluid is :
(A) 2100-4000 (B) 4000
(C) ∞
(D) None of the above

86. The Navier-Stokes equation deals with the low of conservation of :
(A) Energy (B) Mass
(C) Momentum
(D) None of the above

87. Complex potential due to a rectilinear vortex of strength k at z = 0 is :
(A) $\frac{ik}{2\pi}\log z$
(B) $\frac{-ik}{2\pi}\log z$
(C) $\frac{ik}{\pi}\log z$
(D) None of the above

88. The complex potential due to a number of vortex filaments of strength $k_1, k_2 k_3, ...$ at points $z_1, z_2, z_3.......$ is given by :
(A) $W = \sum_{n=1}^{\infty} \frac{ikn}{2\pi}\log(z - z_n)$
(B) $W = \sum_{n=1}^{\infty} \frac{ikn}{\pi}\log(z - z_n)$
(C) $W = \sum_{n=1}^{\infty} \frac{ik}{\pi} n \log(z + z_n)$
(D) None of the above

89. Which of the following correctly defines the Reynolds number (R_e)?
(A) $R_e = \frac{\rho v l}{\mu}$
(B) $R_e = \frac{\rho v z}{\mu}$
(C) $R_e = \frac{\mu v l}{\rho}$
(D) $R_e = \frac{\rho v \mu}{l}$

90. For flow in a pipe if the Reynolds number is less than 2000. Then what type of flow is it?
(A) Laminar flow
(B) Turbulant flow
(C) Oscillatory flow
(D) None of the above

91. The Reynolds number is a measure of :
(A) Turbulance of a fluid
(B) Viscosity of a fluid
(C) Density of a fluid
(D) Pressure of a fluid

92. What factors influence the value of the Reynolds number?
(A) Density, velocity, viscosity, characteristic length
(B) Temperature, pressure, velocity and density
(C) Density, viscosity, temperature and pressure
(D) None of the above

93. For a given fluid flow, if the velocity is increased, what happens to the Reynolds number?
(A) It decreases
(B) It increases
(C) It remain the same
(D) It first increases then decreases

94. Which is the diffusion term of the y-momentum equation?
(A) $\frac{\partial \tau_{xy}}{\partial x}+\frac{\partial \tau_{yy}}{\partial y}+\frac{\partial \tau_{zy}}{\partial z}$
(B) $\frac{\partial \tau_{yx}}{\partial x}+\frac{\partial \tau_{yy}}{\partial y}+\frac{\partial \tau_{yz}}{\partial z}$
(C) $\frac{\partial \tau_{xx}}{\partial x}+\frac{\partial \tau_{yx}}{\partial y}+\frac{\partial \tau_{zx}}{\partial z}$
(D) None of the above

95. In the Navier-Stokes equations what does the symbol υ represent?
(A) Velocity
(B) Kinematic viscosity
(C) Density
(D) Pressure

96. If a vortex pair is situated within a cylinder of radius a, it will remain at rest, then the distance of either from centre is given by :
(A) $a\left(\sqrt{5}-2\right)\frac{1}{2}$
(B) $a^2\left(\sqrt{5}-2\right)\frac{1}{2}$
(C) $a\left(\sqrt{5}+2\right)\frac{1}{2}$
(D) $a^2\left(\sqrt{5}+2\right)\frac{1}{2}$

97. Let Γ be the circulation round a closed circuit then :
(A) $\frac{D\Gamma}{Dt}=\upsilon\nabla^2\Gamma$
(B) $\frac{D\Gamma}{Dt}=-\upsilon\nabla^2\Gamma$
(C) $\frac{D\Gamma}{Dt}=\frac{1}{2}\upsilon\nabla^2\Gamma$
(D) None of the above

98. The Navier-Stokes equations are a set of which type of equations?
(A) Ordinary differential equations
(B) Partial differential equations
(C) Integral equations
(D) None of the above

99. The viscous force ______ the relative motion between the adjacent layers of a fluid in motion. Which of the following fits best in the sentence?
(A) Never effects
(B) Facilitates
(C) May effect under certain conditions
(D) Opposes

100. The strength of a doublet is :
(A) $\mu = m\delta s$
(B) $\mu = \frac{1}{2}m\delta s$
(C) $\mu = \frac{1}{3}m\delta s$
(D) $\mu = \frac{1}{5}m\delta s$

Rough Work

Example :

Question :

Q.1 Ⓐ ● Ⓒ Ⓓ

Q.2 Ⓐ Ⓑ ● Ⓓ

Q.3 Ⓐ ● Ⓒ Ⓓ

5. Each question carries equal marks. Marks will be awarded according to the number of correct answers you have.

6. All answers are to be given on OMR Answer Sheet only. Answers given anywhere other than the place specified in the answer sheet will not be considered valid.

7. Before writing anything on the OMR Answer Sheet, all the instructions given in it should be read carefully.

8. After the completion of the examination, candidates should leave the examination hall only after providing their OMR Answer Sheet to the invigilator. Candidate can carry their Question Booklet.

9. There will be no negative marking.

10. Rough work, if any, should be done on the blank pages provided for the purpose in the booklet.

11. To bring and use of log-book, calculator, pager & cellular phone in examination hall is prohibited.

12. In case of any difference found in English and Hindi version of the question, the English version of the question will be held authentic.

Impt. On opening the question booklet, first check that all the pages of the question booklet are printed properly. If there is any discrepancy in the question Booklet, then after showing it to the invigilator, get another question Booklet of the same series.

उदाहरण :

प्रश्न :

प्रश्न 1 Ⓐ ● Ⓒ Ⓓ

प्रश्न 2 Ⓐ Ⓑ ● Ⓓ

प्रश्न 3 Ⓐ ● Ⓒ Ⓓ

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।

6. सभी उत्तर केवल ओ०एम०आर० उत्तर-पत्रक (OMR Answer Sheet) पर ही दिये जाने हैं। उत्तर-पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।

7. ओ०एम०आर० उत्तर-पत्रक (OMR Answer Sheet) पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाये।

8. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी OMR Answer Sheet उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें। परीक्षार्थी अपने साथ प्रश्न-पुस्तिका ले जा सकते हैं।

9. निगेटिव मार्किंग नहीं है।

10. कोई भी रफ कार्य, प्रश्न-पुस्तिका में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।

11. परीक्षा-कक्ष में लॉग-बुक, कैल्कुलेटर, पेजर तथा सेल्युलर फोन ले जाना तथा उसका उपयोग करना वर्जित है।

12. प्रश्न के हिन्दी एवं अंग्रेजी रूपान्तरण में भिन्नता होने की दशा में प्रश्न का अंग्रेजी रूपान्तरण ही मान्य होगा।

महत्वपूर्णः प्रश्नपुस्तिका खोलने पर प्रथमतः जाँच कर देख लें कि प्रश्नपुस्तिका के सभी पृष्ठ भलीभाँति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्षनिरीक्षक को दिखाकर उसी सिरीज की दूसरी प्रश्नपुस्तिका प्राप्त कर लें।