KUMARAGURU
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GENERAL INSTRUCTIONS TO THE CANDIDATES

1. Candidates are instructed to answer the questions as per Bloom's Taxonomy knowledge level (K_1 to K_6)
2. Candidates are strictly instructed not to write anything in the question paper other than their roll number.
3. Candidates should search their pockets, desks and benches and handover to the Hall Superintendent/ Invigilator if any paper, book or note which they may find therein as soon as they enter the examination hall.
4. Candidates are not permitted to bring electronic watches with memory, laptop computers, personal systems, walkie-talkie sets, paging devices, mobile phones, cameras, recording systems or any other gadget / device /object that would be of unfair assistance to him / her.
5. Corrective measures as per KCT examination policies will be imposed for malpractice in the hall like copying from any papers, books or notes and attempting to elicit the answer from neighbours.

B.E DEGREE EXAMINATIONS: DEC 2015
(Regulation 2014)
Third Semester
MECHANICAL ENGINEERING
U14MET301: Fluid Mechanics And Machinery

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 1 = 10 Marks)

1. Which of the following best describes the physical meaning of the Reynolds number   CO1 [K_3]
   - a) Ratio of viscous drag to inertia
   - b) Ratio of viscous drag to form drag
   - c) Ratio of inertia to viscous drag
   - d) Ratio of form drag to viscous drag

2. Choose the following statements accurately describes Eulerian and Lagrangian mechanics or reference frames   CO2 [K_4]
   - a) A neutrally buoyant weather balloon makes pressure measurements in an Eulerian reference frame
   - b) An anemometer at the top of Mount Washington makes wind velocity measurements in an Eulerian reference frame
   - c) The fixed laboratory reference frame is a Lagrangian reference frame
   - d) Neither Lagrangian nor Eulerian viewpoints can be exactly correct

3. Guide angle as per the aerofoil theory of Kaplan turbine blade design is defined as the angle between   CO4 [K_4]
   - a) Lift and Resultant Force
   - b) Drag and Resultant Force
   - c) Lift and Tangential Force
   - d) Resultant Force and Tangential Force

4. Maximum theoretical suction lift for water at 15°C by a centrifugal pump is 34 ft. The same for water at 90°C will be _____ ft   CO5 [K_4]
   - a) 34
   - b) 8
   - c) 40
   - d) 37

5. Two dimensional flow occurs when the   CO1 [K₂]

a)	Directional and magnitude of the velocity at all points are identical	b)	Velocity of successive fluid particles, at any point, is same at successive periods of time
c)	Magnitude and direction of velocity, do not change from point to point in the fluid	d)	Fluid particles move in a plane or parallel planes and the streamline patterns are identical in each plane

6. Interpret the following statements   CO1 [K₂]

1. Gases are considered incompressible when Mach number is less than 0.2

2. A Newtonian fluid is incompressible and non-viscous

3. An ideal fluid has negligible surface tension

Which of these statements is / are correct?

a)	2 and 3	b)	2 alone
c)	1 alone	d)	1 and 3

7. Consider the following energies associated with a Pelton turbine: CO4 [K₂]

1. Mechanical energy

2. Kinetic energy

3. Potential energy

The correct sequence of energy conversion starting from the entry of fluid is

a)	1, 2 and 3	b)	2, 3 and 1
c)	3, 2 and 1	d)	1, 3 and 2

8. Assertion (A): In a fluid, the rate of deformation is far more important than the total deformation itself.   CO1 [K₂]

Reason (R): A fluid continues to deform so long as the external forces are applied

a)	Both A and R are individually true and R is the correct explanation of A	b)	Both A and R are individually true but R is not the correct explanation of A
c)	A is true but R is false	d)	A is false but R is true

9. Assertion (A): In general, viscosity in liquids increases and in gases it decreases with rise in temperature.   CO1 [K₂]

Reason (R): Viscosity is caused by intermolecular forces of cohesion and due to transfer of molecular momentum between fluid layers; of which in liquids the former and in gases the later contribute the major part towards viscosity.

a)	Both A and R are individually true and R is the correct explanation of A	b)	Both A and R are individually true but R is not the correct explanation of A
c)	A is true but R is false	d)	A is false but R is true

10. Match List-I (Variable) with List-II (Dimensional Expression) and select the correct answer using the codes given below the lists: CO3 [K₂]

VARIABLE	DIMENSIONAL EXPRESSION
A.Force	1. T^{-1}
B.Dynamic Viscosity	2.$ML^{-1}T^{-2}$
C.Modulus of Elasticity	3. MLT^{-2}
D.Angular Acceleration	4. $ML^{-1}T^{-1}$

	A	B	C	D
a)	2	4	1	3
b)	3	4	2	1
c)	3	1	2	4

PART B (10 x 2 = 20 Marks)
(Answer not more than 40 words)

11.	Give the classification of fluids?	CO1	[K$_2$]
12.	Enumerate centre of buoyancy	CO1	[K$_4$]
13.	Define momentum equation and Impulse momentum equation?	CO2	[K$_1$]
14.	Express the assumptions used in deriving Bernoulli's equation	CO2	[K$_2$]
15.	Formulate the dimensions for the followings 1)Dynamic viscosity (μ) 2) Mass density (ρ) 3) Force (F) 4) Power (P)	CO3	[K$_4$]
16.	State Froude's model law	CO3	[K$_2$]
17.	Justify Radial flow reaction turbine and their types.	CO4	[K$_1$]
18.	Assess Euler's equation for turbo-machines?	CO4	[K$_5$]
19.	Categorize Centrifugal Pump & Reciprocating Pump.	CO5	[K$_4$]
20.	Define Cavitations.	CO5	[K$_1$]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

21. Analyze the following data for a Francis turbine.Net Head H=60 m, Speed N=700rpm, Shaft Power =294.3Kw, Overall efficiency=84%, hydraulic efficiency=93%, flow ratio=0.20, Breadth ratio n=0.1, outer diameter of the runner =2 x inner diameter of runner, the thickness of vanes occupies 5% of circumferential area of the runner, velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine: CO4   [K$_4$]

    i)Guide Blade Angle

    ii)Runner Vane Angle at inlet and Outlet

    iii)Diameter of runner at inlet and outlet

    iv)Width of the wheel at inlet

22. i) A 15 cm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 15.10cm.Both cylinders are 25cm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 11.77 Nm is required to rotate the inner cylinder at 100 r.p.m., determine the viscosity of the fluid.   (7)   CO1   [K$_2$]

    ii) A U- Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube is 10 cm and the free surface of mercury is   (7)   CO1   [K$_4$]

in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m^2, calculate the new difference in the level of mercury. Sketch the arrangements in both cases.

23. i) Predict an Energy equation and state the assumptions made while deriving the equation   (7)   CO2   [K_4]

  ii) A pipe of 30cm diameter carrying 0.25 m^3/s water. The pipe is bent by $135°$ from the horizontal anti-clockwise. The pressure of water flowing through the pipe is $400KN/m2$.Find the magnitude and direction of the resultant force on the bend   (7)   CO2   [K_1]

24. i) A Pipe of 10cm in diameter and 1000m long is used to pump oil of viscosity 8.5 poise and specific gravity 0.92 at the rate of 1200 lit/min.The first 30m of the pipe is laid along the ground sloping upwards at $10°$ to the horizontal and remaining pipe is laid on the ground sloping upward $15°$ to the horizontal. State whether the flow is laminar or turbulent? Determine the pressure required to be developed by the pump and the power required for the driving motor if the pump efficiency is 60%. Assume suitable data for friction factor, if required.   (7)   CO3   [K_2]

  ii) Derive on the basis of dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends on the angular velocity ω, Speed of advance V, diameters D, dynamic viscosity μ, Mass density ρ and elasticity of the fluid medium which can be denoted by the speed of sound in the medium 'C'.   (7)   CO3   [K_6]

25. i) An inward flow reaction turbine having an overall efficiency of 80% is required to deliver 136 kw. The head H is 16m and the peripheral velocity is 3.3 $\sqrt{H}$.The radial velocity of flow at inlet is 1.1 $\sqrt{H}$.The runner rotates at 120rpm.the hydraulic losses in the turbine are 15% of the flow available energy. Calculate i) diameter of the runner ii) Guide vane angle iii) the runner blade angle at inlet and iv) the Discharge through the turbine.   (7)   CO4   [K_4]

  ii) Obtain an expression for the work done per second by water on the runner of a pelton wheel and draw inlet and outlet velocity triangles for a pelton turbine and indicate the direction of various velocities.   (7)   CO4   [K_2]

26. i) Explain the working of centrifugal pump with neat sketch.   (7)   CO5   [K_2]

  ii) The piston area of a single acting reciprocating pump $0.15m^2$and stroke is 30cm.the water is lifted through a total head of 15m.the area of delivery pipe is $0.03m^2$.if the pump is running at 50rpm,find the percentage slip, coefficient of discharge and power required to drive the pump. The actual discharge is 35 litres per second. Take mechanical efficiency is 0.85.   (7)   CO5   [K_1]

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