



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

MECHATRONICS ENGINEERING

U14MCT304: Mechanics of Fluids for Mechatronics

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Assertion (A): A circular plate is immersed in a liquid with its periphery touching the free surface and the plane makes an angle θ with the free surface. With different values of θ , the position of centre of pressure will be different. CO2 [K₃]
Reason (R): Since the centre of pressure is dependent on second moment of area, with different values of θ , second moment of area for the circular plate will change

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
2. Unlike the viscosity of liquids, the viscosity of gases increases with increase of temperature. This is due to CO1 [K₃]

a) increased cohesive force between molecules	b) increased momentum transfer in the molecules
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- c) decreased momentum transfer in the molecules d) Increase in both cohesive force and momentum transfer
3. The flow coming from a point and moving radially in all direction of a plane at uniform rate is CO3 [K₁]
 a) Ideal flow b) Vortex flow
 c) Source flow d) Uniform flow
4. Consider the following statements about velocity potential: CO3 [K₃]
 1. The velocity potential is a vector function similar to stream function.
 2. It is a fully three dimensional function and not limited to two coordinates.
 3. Velocity potential does not exist at stagnation points.
 4. Velocity potential exist only if flow is irrotational.
 Which of these statement(s) are correct?
 a) 1,2 and 3 b) 1,2 and 4
 c) 1,3 and 4 d) 2,3 and 4
5. Consider the following statements: CO4 [K₃]
 1. The friction factor in laminar flow through pipes is independent of roughness.
 2. The friction factor for laminar flow through pipes is directly proportional to Reynolds number.
 3. In fully turbulent flow through pipes, friction factor is independent of Reynolds number.
 Which of the statement(s) given above are correct?
 a) 1, 2 and 3 b) 1 and 3 only
 c) 2 and 3 only d) 1 and 2 only
6. In flow through a pipe, transition from laminar to turbulent flows does not depend on CO4 [K₂]
 a) Density of fluid b) Length of pipe
 c) Diameter of pipe d) Velocity of the fluid
7. Euler's number is the ratio of CO5 [K₂]
 a) Inertia force to pressure force b) Inertia force to gravity force
 c) Inertia force to elastic force d) Inertia force to viscous force
8. Francis turbine is ---- CO6 [K₁]
 a) A reaction radial flow turbine b) An axial flow turbine
 c) A radial flow turbine d) An impulse turbine
9. Negative slip occurs in a reciprocating pumps, when delivery pipe is CO6 [K₁]
 a) long and suction pipe is short and pump is running at slow speed b) long and suction pipe is short and pump is running at high a speed
 c) short and suction pipe is long and pump is running at slow speed d) short and suction pipe is long and pump is running at high a speed

10. Match list I (Specific Speed) with List II (Expression / magnitude) and select the correct answer. CO6 [K₂]

List I	List II
A. Specific speed of turbine	i. $N \sqrt{Q} / H^{3/4}$
B. Specific speed of pump	ii. $N \sqrt{P} / H^{5/4}$
C. Specific speed of pelton wheel	iii. 50 – 250
D. Specific speed of Francis turbine	iv. 10 – 50

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| | A | B | C | D |
| a) | iii | iv | i | ii |
| b) | iii | ii | i | iv |
| c) | ii | i | iv | iii |
| d) | i | ii | iv | ii |

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

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| 11. State Newton's law of viscosity. | CO1 [K ₁] |
| 12. Define the terms: (i) Total pressure (ii) Centre of pressure. | CO2 [K ₁] |
| 13. Differentiate between compressible and incompressible flow. | CO3 [K ₂] |
| 14. How do you obtain a velocity at a point in a fluid flow? | CO3 [K ₃] |
| 15. List the various losses through pipe line. | CO4 [K ₁] |
| 16. Define hydraulic and energy gradient line. | CO4 [K ₁] |
| 17. Give differences between geometric similarity and kinematic similarity. | CO5 [K ₂] |
| 18. A turbine develops 5 MW under a head of 20 m at 125 rpm. Find the specific speed of the turbine. | CO6 [K ₂] |
| 19. Draw the performance characteristic curves of the centrifugal pump. | CO6 [K ₂] |
| 20. List the advantages of air vessel used in a reciprocating pump. | CO6 [K ₁] |

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

Q.No. 21 is Compulsory

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| 21. A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a total head of 50 m. The velocity of flow through the impeller is constant and equal to 2.5 m / sec. The vanes are set back at an angle of 45° at outlet. If the outer diameter of the impeller is 600 mm and width at outlet is 60 mm. Determine (i). Vane angle at inlet (ii). Work done by impeller on water per second and (iii) Manometric efficiency. | CO6 [K ₃] |
| 22. Derive an expression to find out the total pressure force and centre of pressure acting on the plane surface immersed in a static fluid at any angle. | CO2 [K ₄] |
| 23. Calculate the flow rate of water flowing through the pipe of 350 mm diameter is placed in an inclined position where the venturimeter is inserted, having throat diameter of 175 mm. The difference of pressure between the main and throat is measured by a liquid of specific gravity 0.6 in an inverted U- tube manometer which gives a reading of 300 mm. The loss of head between the main and throat is 0.25 times the kinetic head of the pipe. | CO3 [K ₃] |
| 24. Derive Hagen - Poiseuille's equation for a fluid flow through a circular pipe and state the assumption made. | CO4 [K ₂] |
| 25. The pressure difference Δp in a pipe of diameter D and length L due to turbulent flow depends on the velocity V, viscosity μ , density ρ , and pipe roughness k. Using Buckingham's π – theorem, derive the expression for Δp . | CO5 [K ₃] |
| 26. Explain in detail about the working of bourdon tube pressure gauge and bellows type pressure gauge with a neat sketch. | CO2 [K ₂] |
