Reg No.:_______________ Name:__________________________

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Third Semester B.Tech Degree Examination December 2020 (2019 Scheme)

## Course Code: IET203
## Course Name: FLUID MECHANICS AND HYDRAULIC MACHINES

**Time: 3 hours** **Max. Marks: 100**

## PART A
### Answer all questions

| | | |
|---|---|---|
| 1 | Illustrate compressibility of fluids. | 3 |
| 2 | How shear stress and velocity gradient in fluids are related? | 3 |
| 3 | Differentiate steady and unsteady flows with examples. | 3 |
| 4 | Define Reynolds number. State its significance. | 3 |
| 5 | Draw a lay out representing classification of notches and weirs. | 3 |
| 6 | Write steps to derive the formula for discharge through a rectangular notch. | 3 |
| 7 | Illustrate force developed due to impact of jet on a fixed flat plate. | 3 |
| 8 | Explain work done by impact of jet on a moving curved plate. | 3 |
| 9 | Distinguish various heads in a Centrifugal pump. | 3 |
| 10 | List out the parameters affecting performance of a pump. | 3 |

## Part B
### Answer any one full question from each module

### Module 1

| | | |
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| 11a | Prove Pascal's law. Quote a practical example. | 7 |
| 11b | With neat sketches, illustrate the working of different mechanical pressure gauges in practice. | 7 |
| 12a | Derive expression for metacentric height of a floating body. | 7 |
| 12b | The diameter and height of a solid cylinder floating in water are 6 m and 8 m respectively. If the specific gravity of the material of the cylinder is 0.8, find its metacentric height and state whether the equilibrium is stable or unstable. | 7 |

## Module 2

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| 13a | With a neat sketch, derive continuity equation in 3D. | 7 |
| 13b | Flow field of a fluid is given by $V = xy^2\, i + yz^2\, j + (2x^2yz + yz^2)\, k$. Calculate the velocity and the acceleration at the point (4,3,2). | 7 |
| 14a | Explain the minor energy losses in pipes. | 7 |
| 14b | The diameter of the pipe in a pipe line is suddenly reduced to a lower diameter from 600 mm to 300 mm. If the pressure intensities at larger and smaller pipe sections are 16.7 $N/cm^2$ and 14.6 $N/cm^2$ respectively, find the loss of head due to contraction (Cc = 0.62). Also determine the discharge through this pipe section. | 7 |

## Module 3

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| 15a | Derive expression for discharge through a triangular notch. | 7 |
| 15b | Discharge through an orifice provided in an overhead tank is 100 litres/second. The diameter of the orifice is 130 mm. The constant head maintained in the tank is 10 m. A point on the jet profile, measured from the vena contracta has co-ordinates 5 m horizontal and 0.6 m vertical. Find the hydraulic coefficients of the orifice. | 7 |
| 16a | Give an overview on constructional details of a Venturimeter. Also illustrate steps to derive discharge through a Venturimeter. | 7 |
| 16b | With neat sketches, illustrate the various arrangements of Pitot tube and Pitot-static tube for measuring velocity of flow in pipelines. | 7 |

## Module 4

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|---|---|---|
| 17a | Draw velocity triangles for a moving unsymmetrical curved plate due to impact of jet. Derive an expression for work done per second by the jet. | 7 |
| 17b | The mean bucket diameter of a Pelton wheel is 1.5 m. It is running at 1200 rpm. The net head on the Pelton wheel is 750 m. The side clearance angle is $20^0$ and discharge through the nozzle is 0.15 $m^3/s$. Find the power available at the nozzle and the hydraulic efficiency of the turbine. | 7 |

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|---|---|---|
| 18a | Give an overview on constructional details and working of Kaplan turbine. Make sketches. | 7 |
| 18b | Design a Kaplan Turbine to develop shaft power of 800 kW. Assume the requisite data - Net available head - 6 m, Speed ratio - 2.5, Flow ratio - 0.7 and the overall efficiency - 65%. The diameter of the boss is taken as ⅓ rd of the diameter of the runner. | 7 |

## Module 5

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|---|---|---|
| 19a | Illustrate working of a Centrifugal pump. Make sketches. | 7 |
| 19b | The outer and inner diameter of the impeller of a centrifugal pump are 700 mm and 300 mm respectively. The width of the impeller at outlet is 20 mm. Speed of the impeller is1200 rpm and the head available is 50 m. The velocity of flow through the impeller is constant and equal to 3 m/s. The vanes are set back at an angle of $45^o$. Determine (a) Vane angle at inlet (b) Work done by impeller on water per second and (c) Manometric efficiency. | 7 |
| 20a | Differentiate between Reciprocating pump and Centrifugal pump. Note the practical applications. | 7 |
| 20b | The speed of a single acting reciprocating pump is 60 rpm. The discharge of the pump is 0.02 $m^3$/s. The diameter of the piston and stroke length are 250 mm and 500 mm respectively. Determine the theoretical discharge of the pump, coefficient of discharge and percentage slip. | 7 |

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