CBCS SCHEME

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BAE303/BAS303

# Third Semester B.E./B.Tech. Degree Examination, June/July 2024
## Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

***Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.***
***2. M : Marks , L: Bloom's level , C: Course outcomes.***

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | State Newton's law of viscosity and explain Newtonian and non-Newtonian fluids with suitable plot. | 6 | L2 | CO1 |
| | b. | Define absolute gauge and Vacuum pressure. Also bring out the relation between the same. | 4 | L1,2 | CO1 |
| | c. | An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of the shaft is 0.5m and it rotates at 200rpm. Calculate the power lost in oil for a sleeve length of 100mm. The thickness of oil is 1.0mm. | 10 | L3 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Give reasons for the following :<br>i) Viscosity of liquid decreases with increase in temperature where as viscosity of gas increases with increase in temperature.<br>ii) Rain drops and tiny dew drops are special in shape. | 6 | L3 | CO2 |
| | b. | VTU is paying Rs. 6.55/kWh for electric power. To reduce its power bill. The VTU installs a wind turbine with a rated power of 30kW. If turbine operates 2200 hours per year at the rated power, determine the amount of electric power generated by the wind turbine and the money saved by the VTU per year. | 4 | L4 | CO2 |
| | c. | State and prove a Pascal's law. | 10 | L2 | CO1 |
| | | **Module – 2** | | | |
| Q.3 | a. | Briefly explain different types of fluid flow. | 8 | L1,2 | CO2 |
| | b. | Which usual notations derive momentum equation in integral form for a compressible fluid flow? | 12 | L2 | CO2 |
| | | **OR** | | | |
| Q.4 | a. | Define velocity potential, stream function and prove that the product of the slope of the equipotential line and constant stream line at a point of intersection in equal to (-1). | 12 | L1,3 | CO1 |
| | b. | Explain sources, sink and doublet flow. | 8 | L1 | CO2 |
| | | **Module – 3** | | | |
| Q.5 | a. | State and prove Bernoulli's theorem and also state the assumptions made for same. | 10 | L2 | CO1 |
| | b. | A pump has a tapering pipe running full of water. The pipe is placed vertically with the diameter at the base and top being 1.2m and 0.6m respectively. The pressure at the upper end is 240mm of Hg vacuum, while the pressure at the lower end is 15kN/m$^2$. Assume the head loss to be 20% of difference of velocity head. Determine the discharge the flow is vertically upwards and difference of elevation in 3.9m. | 10 | L3 | CO3 |

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|---|---|---|---|---|---|
| | | **OR** | | | |
| **Q.6** | **a.** | The efficiency ($\gamma$) of a fan depends on density, dynamic viscosity of the fluid, angular velocity, diameter of the rotor and discharge. Express efficiency in terms of dimensionless parameter using the Buckingham's $\pi$ theorem. | **10** | **L3** | **CO2** |
| | **b.** | Define similitude and briefly explain types of similarities. | **10** | **L2** | **CO2** |
| | | **Module – 4** | | | |
| **Q.7** | **a.** | Derive on the expression for drag and lift. | **10** | **L2** | **CO3** |
| | **b.** | A jet plane which weights 29.43kN and having a wing area of $20m^2$ flies at a velocity of 950Km/hr, when the engine delivers 7357.5kW power, 65% of the power is used to overcome the drag resistance of the wing. Calculate the coefficient of lift and drag for the wing. The density of the atmospheric air is $1.21kg/m^3$. | **10** | **L3** | **CO2** |
| | | **OR** | | | |
| **Q.8** | **a.** | State and explain Kutta-Joukowski theorem. | **5** | **L2** | **CO2** |
| | **b.** | With a neat sketch, briefly explain boundary layer theory. | **5** | **L2** | **CO3** |
| | **c.** | A kite 0.8m × 0.85m weighting 3.924N assumes an angle 12° to the horizontal. The string attached to the kite rake an angle of 45° to the horizontal. The pull on the string is 24.525N. When the wind is flowing at a speed of 30km/hr if the density of the air is $1.25kg/m^3$. Find the corresponding coefficient of drag and lift. | **10** | **L3** | **CO3** |
| | | **Module – 5** | | | |
| **Q.9** | **a.** | Define stagnation point and derive an expression for stagnation pressure for a compressible flow. | **10** | **L2** | **CO2** |
| | **b.** | Define Mach number and derive an expression for the same. | **5** | **L2** | **CO1** |
| | **c.** | Sketch the propagation of pressure wave in a compressible fluid for supersonic flow and define mach cone and mach angle. | **5** | **L2** | **CO3** |
| | | **OR** | | | |
| **Q.10** | **a.** | Derive :<br>i) velocity of sound in terms of bulk modulus<br>ii) velocity of sound in isothermal process<br>iii) velocity of sound for adiabatic process. | **15** | **L2** | **CO2** |
| | **b.** | An airplane is flying at an altitude of 15km, when the temperature is -50°C. The speed of the plane corresponds to the mach number of 1.6. Assuming K = 1.4 and R = 2573/kg K for air. Find the speed of the plane and mach angle. | **5** | **L3** | **CO3** |

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