MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

III SEMESTER B.TECH. EXTERNAL EXAMINATIONS JAN' 2022

SUBJECT: FLUID FLOW OPERATIONS [BIO 2154]

Date of Exam: 20/01/2022 Time of Exam: 4.00 PM – 4.50 PM Max. Marks: 30

PART-A

https://forms.office.com/r/kLkSiHqckZ

Q. No.		Marks	CO	BLT
1.	Non-linear relationship between shear stress and shear rate exists in _____. a. Newtonian fluids b. **Non-Newtonian fluids c. Both d. None of these	1	1	2
2.	The flow in a pipe whose valve is being opened or closed gradually is an example of ____. a. Rotational flow b. Steady flow c. **Unsteady flow d. Compressible flow	1	1	2
3.	The Bernoulli's equation written in the conventional form $P/\varsigma g + v^2/2g + h$ = constant represents total energy per unit of certain quantity. Identify this quantity from the choices given below a. Energy per unit mass b. **Energy per unit weight c. Energy per unit volume d. Energy per unit specific weight	1	1	2
4.	The fluid property, due to which, mercury does not wet the glass is_____. a. Surface tension b. Viscosity c. Adhesion d. **Cohesion	1	1	2
5.	A pressure of 50 m head of water is equal to _____. a. 50 kPa b. **490.5 kPa c. 4905 kPa d. 49.05 kPa	1	1	3
6.	The flow of a liquid through tapering pipe at a constant rate is an example of _____ flow. a. Steady uniform	1	1	3

	b. Unsteady non uniform c. **Steady non uniform d. Unsteady uniform			
7.	A solid can resist which of the following stresses? a. Tensile b. Compressive c. Shear d. **All of them	**1**	**1**	**3**
8.	A Newtonian fluid is one in which the viscosity a. **is constant regardless of the stirrer speed or mixing time b. Changes during mixing but returns to its original state after mixing c. Increases with increasing stirrer speed d. Decreases with increasing stirrer speed	**1**	**1**	**3**
9.	A liquid flows through pipes 1 and 2 with the same flow velocity. If the ratio of their pipe diameters D_1:D_2 be 3:2, what will be the ratio of the head loss in the two pipes? a. 3:2 b. 9:4 c. **2:3 d. 4:9	**1**	**2**	**4**
10.	Navier-Stokes equation describes the motion of _____. a. Solid substance b. Non-viscous fluid c. **Viscous fluid d. Gas	**1**	**2**	**2**
11.	The velocity profile for Poiseuille flow? a. Zero b. Constant c. Linear d. **Quadratic	**1**	**2**	**2**
12.	In a hydro-project a turbine has a head of 50 m. The discharge in the feeding penstock is 3.0 m^3/s. If a head loss of 5 m takes place due to losses, and a power of 1000 kW is extracted, the residual head downstream of the turbine is a. 5.0 m b. 15.95 m c. **11.00 m d. 20.95 m	**1**	**2**	**3**
13.	A two-meter-high tank is full of water; a hole is made in the middle of the tank. The speed of efflux is; a. 4.9 m/s b. 9.0 m/s c. **4.42 m/s d. 3.75 m/s	**1**	**2**	**3**
14.	In a turbine having a flow of 1.2 m^3/s the net head is 120 m. if the efficiency of the turbine is 90 % the shaft power developed, in kW, is a. 1440 b. 1566	**1**	**2**	**3**

	c. 160 d. **1270			
15.	In a pump the suction and delivery pipes are of the same size and are at the same level. At a given discharge the loss of head between a point A on the suction side and a point B on the delivery side is 3.0 m. If the pressure at point B is 120 kPa and the head developed by the pump is 10 m, the pressure at point A is a. **51.5 kPa b. -188.6 kPa c. -7.25 kPa d. 29.37 kPa	**1**	**2**	**3**
16.	For a solid sphere falling under gravity at terminal velocity in a fluid a. Buoyant force = drag b. Weight of the body = buoyant force c. **weight of the sphere = buoyant force +drag d. Drag = weight	**1**	**2**	**4**
17.	A streamlined body is defined as a body about which a. The skin friction is zero b. The skin friction is minimum c. The thickness of the body is minimum d. **the separation point occurs on the far downstream part of the body	**1**	**2**	**4**
18.	The shape of a streamlined body is such as to a. Fix the separation points as much ahead as possible b. **Shift the boundary layer separation to the rearmost part thereby considerably reducing the wake-size c. Make the streamline pattern symmetrical d. None of the above	**1**	**2**	**4**
19.	The terminal velocity of a body in a stationary mass of fluid corresponds to the situation when the _____. a. Body acquires a constant velocity in any direction b. **Net force acting on the body equals zero c. Weight of the body equals the buoyancy force acting on it d. Net force acting on the body acts in verticle direction	**1**	**2**	**2**
20.	For liquid flow through a packed bed, the superficial velocity as compared to average velocity through the channel in the bed is _____. a. more b. **less c. equal d. Independent of porosity	**1**	**3**	**2**
21.	When a circular cylinder is rotated in a uniform flow, a lift force is produced on the cylinder which is caused by a. **The pressure difference between the two halves, the bottom-half being subjected to a higher pressure b. The symmetrical streamline patterns c. The shear stresses due to viscous action d. None of the above	**1**	**1**	**2**

22.	Which factor is considered in Ergun equation when the Reynold's number is greater than 1000? a. 150 b. **1.75 c. 4/6 d. 72	**1**	**3**	**3**
23.	The ratio of the specific weight of the liquid to the specific weight of a standard fluid is known as a. Specific volume b. Weight density c. **Specific gravity d. viscosity	**1**	**1**	**4**
24.	Inclined single column manometer is useful for the measurement of ____ pressure. 1. **small 2. medium 3. high 4. negative	**1**	**1**	**4**
25.	The total energy represented by the Bernoulli's equation {P/w + V^2/2g + z} has the units: 1. Nm/s 2. Ns/m 3. Nm/m 4. **Nm/N	**1**	**2**	**2**
26.	Any pressure measured above the absolute zero of pressure is termed as_____. a. Atmospheric pressure b. Gauge pressure c. **either of the above d. None of the above	**1**	**1**	**4**
27.	For turbulent flow in smooth pipes, the entrance length is taken as a. 20 b. **50 c. 80 d. 115	**1**	**2**	**3**
28.	Velocity head is given by _____. a. V/g b. **V^2/2g c. V^3/2g d. $V^2/2g^2$	**1**	**2**	**2**
29.	The type of flow in which the velocity at any given time does not change with respect to space is called _____. a. Steady flow b. Compressible flow c. **Uniform flow d. Rotational flow	**1**	**1**	**4**

30.	The viscosity of liquids _____ with increase in temperature. a. increases b. first increases and then increases c. first increases and then decreases d. **decreases	**1**	**1**	**4**

CO: Course Outcome; BLOOM TAXONOMY LEVEL: 1-Remember, 2-Understand, 3-Application, 4-Analysis, 5-Evaluation, 6-Creation

Name & Signature of course coordinator | **Name & Signature of scrutinizer** | **Signature of HOD**

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SUBJECT: FLUID FLOW OPERATIONS [BIO 2154]

Date of Exam: 20/01/2022 Time of Exam: 2:00 PM – 3:45 PM Max. Marks: 20

Instructions to Candidates:

- Answer ALL the questions & missing data may be suitable assumed

PART-B

Q. No.		Marks	CO	BLT
1A.	Packed bed of small cylindrical particles (D = H = 0.0254 m) Void, $\varepsilon = 0.6$ Height of the bed, L = 5.66 m Air enters at 394.3 K and 2.2 atm air (viscosity = 2.5 x 10^{-5} and density = 1.221 kg/m^3) Air flow rate = 3.55 kg/m^2.s (based on empty cross sectional area of the bed). What is the pressure drop?	**3**	**3**	**2-4**
1B.	A substrate solution of density 1000 kg/m^3 and viscosity 4 mNs/m^2 is passed vertically upwards through a bed of immobilized enzymes as catalysts consisting of approximately spherical particles of diameter 0.2 mm and density 2800 kg/m^3. At approximately what mass rate of flow per unit area of bed will (a) Fluidization and (b) Transport of particles occur? Assume voidage at incipient fluidization as 0.58.	**4**	**3**	**2-4**
1C.	A cylindrical fermenter of diameter 4 m has four baffles is used to culture an anaerobic organism. A Rushton turbine mounted in the reactor is operated at a speed of 180 rpm. The density of broth is 990 kg/m^3. Calculate the power requirements when the viscosity of the broth is approximately that of water. Use the following relationships for different flow conditions: **Type of flow** | **Power number correlation** *Laminar* | $N_P = 7000 / Re_i$ *Transition* | $N_P = 700 / Re_i$ *Turbulent* | $N_P = 7 + (1/Re_i)$	**3**	**4**	**2-4**
2A.	A venturimeter of throat diameter 4 cm is fitted into a 10.5 cm diameter water pipeline. The coefficient of discharge is 0.96. Calculate the flow in the pipeline when the reading on a mercury-water differential U-tube manometer connected to the upstream and the throat sections shows a reading of 15 cm. If the energy loss in the downstream divergent cone of the meter is 10 times the velocity head in the pipe, calculate the total head loss of the meter.	**4**	**4**	**2-4**

2B.	Design the diameter of a steel pipe to carry water ($v = 1 \times 10^{-6}$ m^2/s) with a mean velocity of 1.0 m/s. The head loss is to be limited to 10 cm per 100 m length. The effective roughness height can be taken as 0.45 mm. Use the following empirical formula for the friction factor. $$f = 0.0055\left[1 + \left(2000\frac{\varepsilon_s}{D} + \frac{10^6}{Re}\right)^{1/3}\right]$$	**4**	**2**	**3-4**
2C.	A glass sphere (relative density = 2.8) 3.0 mm in diameter is observed to have a fall velocity of 1.75 cm/s in a oil of density 920 kg/m^3. Estimate the coefficient of dynamic viscosity of the oil. Assume Stoke's law is valid.	**2**	**2**	**3-4**
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