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PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST - 1

Even Semester: 2018-19 | **Date**: 05 March 2019

Course Code: PET 222 | **Time**: 1 Hour

Course Name: Heat Mass and Momentum Transfer | **Max Marks**: 40

Programme & Sem: B.Tech (PET) & IV Sem | **Weightage**: 20%

Instructions:

(i) ***Read the question properly and answer accordingly.***

(ii) ***Question paper consists of 3 parts.***

(iii) ***Scientific and Non-programmable calculators are permitted.***

Part A

Answer **all** the Questions. **Each** question carries **four** marks. (3Qx4M=12)

1. Write rheological characteristics of fluids in a tabular form with examples
2. What are the four types of possible fluid flows? Explain with example:-
3. Write the equation of a) Motion of fluid b) Navier-Stokes equation c) Euler's equation Explain when Navier-Stokes equation and Euler's equation can be applied.

Part B

Answer **both** the Questions. **Each** question carries **eight** marks. (2Qx8M=16)

4. In the equipment shown in Figure1, a pump draws a solution of specific gravity 1 from a storage tank through a 3 in. pipe of cross sectional area 0.0513 ft^2. The efficiency of the pump is 60 percent. The velocity in the suction line is 4 ft/s. The pump discharges through a 2 in. pipe of cross sectional area 0.0233 ft^2 to an overhead tank. The end of the discharge pipe is 50 ft above the level of the solution in the feed tank. Friction losses in the entire piping system are 15 ft-lbf/lb. What pressure must the pump develop? What is the power of the pump in hp and kW?

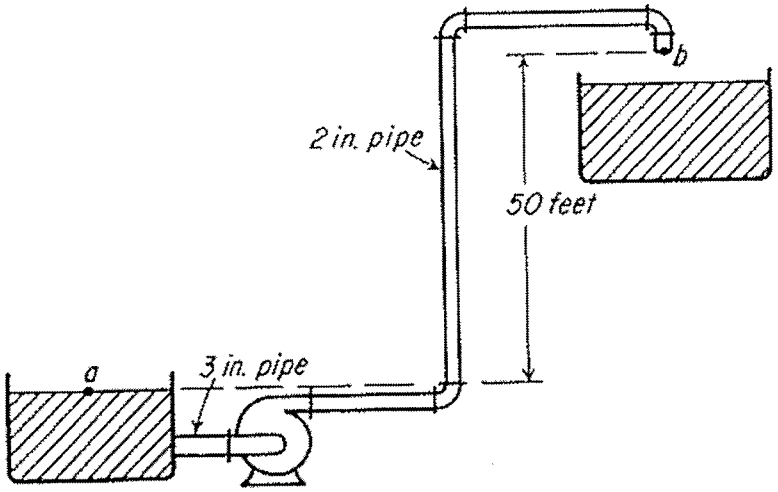

Figure 1

5. Find an expression for the drag force (F) on smooth sphere of diameter, D, moving with a uniform velocity, V, in a fluid density, ρ and dynamic viscosity, μ.

Part C

Answer the Question. Question carries **twelve** marks. (1Qx12M=12)

6. The resistance R experienced by a partially submerged body depends upon the velocity – v, length – l, viscosity of fluid – μ, density of fluid – ρ, and gravitational acceleration – g. Obtain a dimensionless expression for resistance R ($R = MLT^{-2}$).

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BENGALURU

SCHOOL OF ENGINEERING

TEST - 2

Even Semester: 2018-19 | **Date**: 15 April 2019

Course Code: PET 222 | **Time**: 1 Hour

Course Name: Heat Mass and Momentum Transfer | **Max Marks**: 40

Program & Sem: B.Tech & IV Sem | **Weightage**: 20%

Instructions:

(i) ***Read the question properly and answer accordingly.***

(ii) ***Question paper consists of 3 parts.***

Part A

Answer **All** the Questions. **Each** question carries **four** marks. (3Qx4M=12)

1. Write Hagen-Poiseuille equation for pressure loss and head loss in a pipe with laminar flow.

2. Write about velocity distribution for turbulent flow in pipes and channels.

3. Define drag coefficient equation and write its equation. What will be the equation for drag coefficient for a sphere of diameter D_p and Reynolds number less than 1.

Part B

Answer **both** the Questions. **Each** question carries **eight** marks. (2Qx8M=16)

4. Describe the isentropic expansion, adiabatic expansion and isothermal frictional flow of a gas in pipe with suitable diagram.

5. Name various types of fluidization. Write applications of fluidization. Write advantages and disadvantages of fluidization.

Part C

Answer the Question. The Question carries **twelve** marks. (1Qx12M=12)

6. a) Write about nature of heat flow, conduction, convection, radiation, natural and forced convection. [9M]
   b) Write equation for heat conduction through plane of wall and through composite walls. [3M]

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SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Even Semester: 2018-19 | **Date**: 22 May 2019

Course Code: PET 222 | **Time**: 3 Hours

Course Name: Heat, Mass and Momentum Transfer | **Max Marks**: 80

Program & Sem: B.Tech & IVth Sem | **Weightage**: 40%

Instructions:

(i) Read the question properly and answer accordingly.

(ii) Question paper consists of 3 parts.

(iii) Appendix tables are included at the end, use them as per requirement of question.

Part A

Answer **all** the Questions. **Each** question carries **five** marks. (4Qx5M=20M)

1. Match the following dimensionless numbers with their formulae

Numbers	Formulae
i. Reynolds Number	a. $\frac{\mu}{\rho D_{AB}}$
ii. Prandtl Number	b. $\frac{Sc}{Pr}$
iii. Schmidt Number	c. $\frac{\rho u D}{\mu}$
iv. Lewis Number	d. $\mathrm{Re} \times \mathrm{Pr}$
v. Peclet Number	e. $\frac{C_P \mu}{K}$

2. Match the following values with their conversion values

Values	Equivalent Values
i. 54 lb/ft^3	a. 10^5 N/m^2
ii. 1 bar	b. 865 kg/m^3
iii. 1 N.m	c. 1 erg
iv. 1 dyn.cm	d. 1 kg.m^2/s^2
v. 40 gal/min	e. 9.09 m^3/h

3. Match the following fluids with their examples

Fluids	Examples
i. Pseudoplastic	a. Bentonite clay suspensions
ii. Thixotropic	b. Mayonnaise
iii. Newtonian	c. Starch in water
iv. Dilatant	d. Shortening
v. Rheopectic	e. Most simple liquids

4. Fill in the blanks:
   i. A surface is said to be hydraulically smooth when _____.
   ii. Kinematic viscosity is ratio of _____.
   iii. Euler's equation is applicable for fluids with _____.
   iv. What is the velocity at the interface in turbulent flow_____?
   v. Skin friction is generated in _____ boundary layers.

Part B

Answer **all** the Questions. **Each** question carries **eight** marks. (5Qx8M=40M)

5. Explain about fluidization and conditions for fluidization.

6. Answer the flowing:
   i. What are the four possible fluid flows write with an example. [4M]
   ii. Fick's law of diffusion with equation. [2M]
   iii. Dropwise condensation. [2M]

7. i. Using a figure define and explain drag, wall drag and form drag. [4M]
   ii. Air at 20 ℃ blows over a hot plate 50 by 75 cm maintained at 250 ℃. The convection heat transfer coefficient is 25 W/m^2 ℃. Plate is 2 cm thick and lost 300 W from plate surface by radiation, calculate the inside plate temperature. [4M]

8. i. Water at the rate of 60 kg/min is heated from 35 to 65 ℃ by an oil, having a specific heat of 2.1 KJ/Kg ℃. The fluids are used in a counter flow double-pipe heat exchanger, and the oil enters the exchanger at 110 ℃ and leaves at 75 ℃. The overall heat-transfer coefficient is 320 W/m^2 ℃. Calculate the heat exchanger area. [4M]
   ii. Using the above data, if only fluids flow is changed from counter flow to parallel flow what would be the change in heat exchanger area. [4M]

9. Calculate the critical radius of insulation for a material made of asbestos [k = 0.18 W/m℃] surrounding a pipe and exposed to room air at 20℃ with h = 3.2 W/m^2 ℃. Calculate the heat loss from a 200 ℃, 2.5 cm radius pipe when covered with critical radius of insulation and without insulation.

Part C

Answer **all** the Questions. **Each** question carries **10** marks. (2Qx10M=20M)

10. Air at atmospheric pressure and 173 ℃ is cooled as it flows through a tube with a diameter of 2.54 cm at a velocity of 10 m/s. Calculate the heat transfer per unit length of the tube if a constant heat-flux condition is maintained at the wall and the wall temperature is 20 ℃ below the air temperature, all along the length of the tube. How much would the bulk temperature decrease over a 3 m length of the tube?

11. Using Buckingham's π- Method, show that the velocity through a circular orifice is given by

$$V = \sqrt{2gH}\,\emptyset\left[\frac{r}{H}, \frac{\mu}{\rho VH}\right]$$

Where, H = head causing flow, r = radius of the orifice, μ= co-efficient of the viscosity, ρ = mass density and g = acceleration due to gravity

Appendix Tables

Appendix A: Properties of air at atmospheric pressure.

The values of μ, k, c_p, and Pr are not strongly pressure-dependent and may be used over a fairly wide range of pressures

T,K	ρ kg/m^3	c_p kJ/kg·°C	$\mu \times 10^5$ kg/m·s	$\nu \times 10^6$ m^2/s	k W/m·°C	$\alpha \times 10^4$ m^2/s	Pr
100	3.6010	1.0266	0.6924	1.923	0.009246	0.02501	0.770
150	2.3675	1.0099	1.0283	4.343	0.013735	0.05745	0.753
200	1.7684	1.0061	1.3289	7.490	0.01809	0.10165	0.739
250	1.4128	1.0053	1.5990	11.31	0.02227	0.15675	0.722
300	1.1774	1.0057	1.8462	15.69	0.02624	0.22160	0.708
350	0.9980	1.0090	2.075	20.76	0.03003	0.2983	0.697
400	0.8826	1.0140	2.286	25.90	0.03365	0.3760	0.689
450	0.7833	1.0207	2.484	31.71	0.03707	0.4222	0.683
500	0.7048	1.0295	2.671	37.90	0.04038	0.5564	0.680

Appendix B: Properties of water (saturated liquid).

°F	°C	c_p kJ/kg·°C	ρ kg/m^3	μ kg/m·s	k W/m·°C	Pr	$\frac{g\beta\rho^2 c_p}{\mu k}$ 1/m^3·°C
32	0	4.225	999.8	1.79×10^{-3}	0.566	13.25	
40	4.44	4.208	999.8	1.55	0.575	11.35	1.91×10^9
50	10	4.195	999.2	1.31	0.585	9.40	6.34×10^9
60	15.56	4.186	998.6	1.12	0.595	7.88	1.08×10^{10}
70	21.11	4.179	997.4	9.8×10^{-4}	0.604	6.78	1.46×10^{10}
80	26.67	4.179	995.8	8.6	0.614	5.85	1.91×10^{10}
90	32.22	4.174	994.9	7.65	0.623	5.12	2.48×10^{10}
100	37.78	4.174	993.0	6.82	0.630	4.53	3.3×10^{10}
110	43.33	4.174	990.6	6.16	0.637	4.04	4.19×10^{10}
120	48.89	4.174	988.8	5.62	0.644	3.64	4.89×10^{10}
130	54.44	4.179	985.7	5.13	0.649	3.30	5.66×10^{10}
140	60	4.179	983.3	4.71	0.654	3.01	6.48×10^{10}