Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

III SEMESTER B.TECH (BIOTECHNOLOGY)

MAKEUP EXAMINATIONS, DEC 2015/JAN2016

SUBJECT: FLUID FLOW OPERATIONS IN BIOPROCESSING [BIO 2106]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A.	Distinguish between Newtonian and non-Newtonian fluids.	**3**
1B.	Discuss about the inclined manometer which is used for measuring pressure difference with a neat diagram.	**4**
1C.	Find the pressure represented by a column of 10 cm of water, 50 cm of ethanol (relative density 0.75) and 25 cm of mercury	**3**
2A.	A pipe 50 cm in diameter branches into two pipes of diameters 25 cm and 20 cm respectively. If the average velocity in 50 cm diameter pipe is 4.5 m/sec. Find discharge through 50 cm diameter pipe and velocity in 20 cm diameter pipe if the average velocity in 25 cm pipe is 2.5 m/sec.	**2**
2B.	Waste water (μ = 0.985 cP & ρ = 990 kg/m^3) flows at a rate of 8 x 10^{-4} m^3/sec in an open channel of rectangular cross section. The base of the channel is 2 m wide and the height of the water is 1 m. Is the flow is laminar or turbulent?	**2**
2C.	5 m^3/hr water is pumped in a 50 mm internal diameter pipe through a distance of 250 m in a horizontal direction and then up through a vertical height of 10 m. In the pipe there is a control valve of which equivalent length is 200 pipe diameters and also other pipe fittings has an equivalent length of 60 pipe diameters. What power must be supplied to the pump if it is 75% efficient? {Use f = 0.0014 + (0.125/$N_{Re}^{0.32}$)}.	**6**
3A.	What do you mean by fluidization? How fluidization will aid the bioprocess system? Give its advantages and disadvantages.	**6**
3B.	What are the principal requirements of tower packing in packed bed?	**4**
4A.	A centrifugal fan is used to take flue gas at rest and at a pressure of 720 mm of Hg and a temperature of 93.5°C and discharge it at a pressure of 775 mm of Hg and a velocity of 15.25 m/sec. Calculate the power needed to move 1500 m^3/hr of gas, using standard conditions of 760 mm of Hg and 0°C. The efficiency of the fan is 60% and the molecular weight of the gas is 32.5. Assume incompressible flow.	**5**
4B.	A venturi-meter with a throat diameter of 3 cm is fitted into a 10 cm ID pipeline. The coefficient of venturi is 0.98. Calculate the flow through the meter when the reading on a mercury-water manometer connected across the upstream and throat taps is 25 cm.	**5**
5A.	Elaborate on different types of mixing equipment's used for liquids, solids, pastes and highly viscous fluids.	**6**
5B.	How do you prevent the formation of swirling and vortex during the mixing process in a vessel?	**4**