Master of Power Engineering 1st Sem. Examination, 2017
Subject: Applied Fluid Mechanics

Time: Three hours   Full marks: 100

Answer any 5 question

No. of questions	.	Marks
1.	Find the expression of velocity profile of the flow between two concentric cylinders while the outer cylinder with infinite radius is stationary. Draw the characteristic curves of non-Newtonian fluids with yield stress at zero velocity gradient.	15+5
2.	Using Reynold's Transport Theorem, find the mathematical expression of principle of conservation of energy for steady fluid flow. What do you mean by extensive and intensive property of the fluid? Write the relationship between these two.	14+4+2
3.	What do you mean by Couette flow? Discuss with diagram the velocity profiles for different pressure gradient of flow when fluid flows over a fixed horizontal surface. The tangential velocity of fluid flow at a point within two concentric rotating cylinders (radius R_1 and R_2 and rotating at ω_1 and ω_2 respectively) of infinite length can be expressed by $U_\theta = \left(\dfrac{C_1}{2}\right)r + \left(\dfrac{C_2}{r}\right)$, where Cs are the constants and r is the radius at the point from the centre. Using boundary conditions, find the expression when the inner cylinder rotates within an outer cylinder of infinite radius.	3+5+12
4.	What do you mean by strain rate tensor? What do you mean by bulk viscosity and 2nd coefficient of viscosity? What do mean by Fanno line? Draw the Fanno line curves on h-s plane. Show that the coefficient of pressure on the surface of a cylinder submerged in a fluid flow field is $C_p = \dfrac{(p - p_0)_s}{\dfrac{\mu U_0}{R}}$, symbols have their own meanings.	2+2+6+10

5.	A 3-dmensional flow is described by $V = (y^2 + z^2)\hat{i} + (x^2 + z^2)\hat{j} + (x^2 + y^2)\hat{k}$. Find the components of acceleration and components of rotation at (1,2,3). Velocity field of different incompressible fluid flow are given by $u = x^2 + z^2 + 5$, $v = y^2 + z^2 - 3$. Find whether the flow is irrotational or not.	10+10
6.	What is Stokes theorem for circulation? Prove Stokes theorem. Does a velocity field given by $\overline{U} = 5x^2\hat{i} - 15x^2y\hat{j} + t\hat{k}$ represent a possible 3-D motion of an incompressible fluid? Prove that for the volumetric deformation in a 2-D fluid flow $\sigma_{xx} = \frac{1}{2}\varepsilon_{xx}$, symbols have their own meanings.	2+4+6+8
7.	Find the expression of discharge, velocity and shear stresses for fluid flowing through an annulus pipe. What is Rankine's half body? Find the expression of resultant flow field when uniform rectilinear flow is superimposed with a source flow.	10+10