

Answer to Practice Problem Set-II

ME-231A

| PROBLEM NO. | ANSWER |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | $y = c, y = c/x, y = cx^{-20}$ |
| 2 | $y = 3x, \Delta t = 0.75 \text{ s}$ |
| 3 | $y = (1/2)x^2$, both lines are same because the flow is steady |
| 4 | Pathline- $y = \exp\{(1/2)t^2\}$, stream lines- $y = 1, y = x^{1/2}, y = (2x-1)^{1/3}$ |
| 5 | Stream line - $x = x_o e^{\frac{a(t-t_o)+b(t-t_o)^2}{2}}, y = y_o e^{c(t-t_o)}$ Stream lines- $y = x, y = x^{2/3}, y = x^{1/2}$ |
| 6 | Stream line - $x_{st}(t_o) = x_o e^{\frac{a(t^2-t_o^2)}{2}}, y_{st}(t_o) = y_o + b(t-t_o)$ Path line- $x_p(t) = x_o e^{\frac{a(t^2-t_o^2)}{2}}, y_p(t) = y_o + b(t-t_o)$ |
| 7 | 2D |
| 8 | Incompressible flow, $a = 69.9 \text{ m/s}^2$ |
| 9 | Incompressible flow, along x-axis $a = -100/x^3$, along y axis $a = -100/y^3$, along $y = x$ line $a = -100/(x^2 + y^2)^{3/2}$ |
| 10 | Rotation = -0.5 k rad/s , circulation = $-0.5 \text{ m}^2/\text{s}$ |
| 11 | $\vec{V} = (0.1y + f(x))\hat{i}$, rate of rotation = -0.05 k rad/s , $\psi = \frac{1}{2}Ay^2 + c_1y + c_2$ |
| 12 | Irrotational |
| 13 | Rate of linear deformation is zero in all three direction, angular deformation = $-u_{\max} \frac{2y}{b^2}$, $\bar{\xi} = u_{\max} \frac{2y}{b^2} \hat{k}$, vorticity is maximum at $y = b$ and $y = -b$ |
| 14 | Rate of linear deformation is zero in all three direction, angular deformation = $-V_{\max} \frac{2r}{R^2}$, $\bar{\xi} = -V_{\max} \frac{2r}{R^2} \hat{e}_\theta$ |
| 15 | Linear strain = 0 (in x direction), 0 (in y direction) shear strain rate = U/b , Vorticity = $-(U/b)\hat{k}$ |
| 16 | $\dot{\epsilon}_{rr} = -\frac{Q}{2\pi r^2}, \dot{\epsilon}_{\theta\theta} = \frac{Q}{2\pi r^2}, \dot{\epsilon}_{zz} = 0, \dot{\gamma}_{r\theta} = 0, \dot{\gamma}_{\theta r} = 0, \dot{\gamma}_{rz} = 0, \dot{\gamma}_{zr} = 0, \dot{\gamma}_{\theta z} = 0, \dot{\gamma}_{z\theta} = 0$ |
| 17 | Rotational velocity = $-w_0\hat{k}$, vorticity = $-2w_0\hat{k}$, $\dot{\epsilon}_{xx} = c, \dot{\epsilon}_{yy} = c, \dot{\epsilon}_{zz} = -2c$, $\dot{\gamma}_{xy} = 2w_0, \dot{\gamma}_{yx} = 2w_0, \dot{\gamma}_{yz} = 0, \dot{\gamma}_{zy} = 0, \dot{\gamma}_{xz} = 0, \dot{\gamma}_{zx} = 0$ |
| 18 | The flow field is steady. |