

M.E. MECHANICAL ENGINEERING FIRST YEAR SECOND SEMESTER EXAM - 2019
Second Semester

Subject: Advanced Fluid Mechanics – II

Answer any four questions

Assume any data if not given with proper Justification

Time: Three hours

Full marks: 100

- Q:1.a) How do you transform a circle of radius 'a' to a line of length '4a'? Establish the transformation function through graphical method.
- b) Find the transformation function which transforms the pattern of flow past a circular cylinder to a horizontal flow normal to a vertical plate of length '2a' where 'a' is the radius of the circle. (10+15)
- Q.2.a) State Schwarz-Christoffel theorem.
- b) Following Schwarz-Christoffel theorem, establish the equation for stream-function and potential-function for horizontal flow past a flat plate without separation. (10+15)
- Q.3. Consider a two-dimensional, incompressible turbulent boundary layer flow over a flat surface with zero incidence. Stating the two-dimensional boundary layer equations and using Prandtl's mixing layer hypothesis, show that the velocity distribution very close to the wall (law of the wall) can be expressed by $u^+ = y^+$, where viscous force is dominating over the turbulent shear stresses. (25)
- Q4. With the help of Reynolds experiments explain the instability generated in pipe flow. Show with a graphical representation when a system becomes unstable and stable with the help of amplitude variation. (25)
- Q5. Derive the Orr-Sommerfeld equation for the analysis of Instability. (25)
- Q6. Find Rayleigh's equation and from this show that uniform flow is unconditionally stable while a shear layer i.e. parallel flow jump is unconditionally unstable. (25)
- Q7. Explain Centrifugal Instability and gravitational instability. (25)