Form A: Paper-setting Blank

Ref. No. Ex/PE/T/213/2017(S)

POWER ENGG. 2ND YEAR 1ST SEM SUPPLEMENTARY EXAMINATION, 2017 SUBJECT:

Subject: ***Fluid Mechanics***

Time: Three Hours **Full Marks 100**

Answer any FIVE Questions.

No. of Questions		Marks
1 (a)	How does viscosity of fluids change with temperature and why?	6
(b)	A hydraulic ram 200 mm in diameter and 1.2 m long moves wholly within a concentric cylinder 200.2 mm in diameter, and the annular clearance is filled with oil of relative density 0.85 and kinematic viscosity 400 $mm^2 \cdot s^{-1}$. What is the viscous force resisting the motion when the ram moves at 120mm$\cdot s^{-1}$?	10
(c)	Define co-efficient of compressibility. Find percentage reduction in volume of water if pressure increases by 10^4 kN/m^2 over atmospheric pressure of 1.013 bar. Take Buck Modulus K= 2.19 GN/m^2.	2+2
2 (a)	A flat plate (2D) of arbitrary shape (area A) is immersed in a liquid at an angle θ with free liquid surface. Determine the expression for total force on the plate and the location of centre of pressure.	12
(b)	A piece of wood (sp. gr. = 0.6) of 10 cm square in cross-section and 2.5 m in length floats in water. How much lead (sp. gr. = 12) need to fastened at the lower end of the stick so that it floats upright with 0.5m length out of water?	8
3 (a)	A fluid field is given by $\bar{V} = x^2 yi + y^2 zj - (2xyz + yz^2)k$. Show that flow is possible.	3
(b)	For the velocity field given by $\bar{V} = 10xyi + 5x^2 j + (t^2 x + z)k$, find the velocity and acceleration of a fluid particle at $\bar{r} = \hat{i} + 2\hat{j} + 3\hat{k}$ when time t=1.	10
(c)	A stream function is given by $\psi = 3x^2 y + (2+t)y^2$. Find the velocity field and determine its value at a point (1, 2, -3) when t =2 sec.	7
4 (a)	Determine the velocity distribution for laminar flow of viscous fluid through a pipe of radius '***R***'. Show that the maximum velocity will occur at the center of the pipe.	10
(b)	Derive Darcy-Weisbach equation to determine the major head due to pressurized flow of a fluid through a conduit	10
5 (a)	A 30 cm diameter pipe (penstock) supplies water steadily to a turbine at 0.18 MN/m^2. The water leaves the turbine with a pressure of –0.02 MN/m^2 through a 60 cm pipe (draft tube). A vertical distance of 2.0 m separates the centers of pipe at sections where measurement have been made. Calculate the power required to the turbine for water if 0.30 m^3 of water passes through the arrangement per second. [See Figure Q 5(a) at the end of question paper]	10
(b)	Inlet and throat diameter of a horizontal venturimeter are 30cm and 10cm respectively through water is flowing. The pressure intensity of inlet is 1.3 kgf/cm^2 while vacuum pressure head at the throat is –40 cm of Hg. If 3% of differential head is lost between inlet and outlet Find the flow rate and co-efficient of discharge	10
6 (a)	Show by use of Buckinham's Pi theorem, that velocity through an orifice can be given by $V = \sqrt{2gH}\, f\left(\frac{D}{H}, \frac{\mu}{\rho V H}, \frac{\sigma}{\rho V^2 H}\right)$, where, D = Diameter of the orifice, H = Head, ρ = density of the fluid, μ = viscosity of the fluid, σ = surface tension of the fluid. (Use Buckingham's Pi theorem)	12

Form A: Paper-setting Blank

Ref. No. Ex/PE/T/213/2017(S)

POWER ENGG. 2ND YEAR 1ST SEM SUPPLEMENTARY EXAMINATION, 2017 SUBJECT:

*Subject: **Fluid Mechanics***

Time: Three Hours **Full Marks 100**

(b)	A torpedo-shaped object 900 mm diameter is to move in air at 60 m/s and its drag is to be estimated from tests in water on a half-scale model. Determine the necessary speed of the model and the drag of the full-scale object if that of the model is 1140 N. (Dynamic viscosities: air 1.86×10^{-5} Pa-s; water 1.01×10^{-3} Pa-s. Densities: air 1.20 kg/m^3; water 1000 kg/m^3.)	**8**
7 (a)	Derive the conditions for the most economic trapezoidal channel.	**10**
(b)	A trapezoidal channel is required to carry 6 m^3/s of water at a velocity of 1.5 m/s. find the most economic cross section if the channel has the side slopes of 1 vertical to 2 horizontal (n =1/2). Also find the head per kilometer length of the channel. Take Chezy constant as 66 m$^{1/2}$s^{-1}.	**10**
8 (a)	Derive the velocity of sound wave for compressible fluid when the process is assumed as isentropic.	**8**
(b)	With a diagram show the 'Mach Cone', Mach angle, Mach line, zone of silence and zone of action for a supersonic flow.	**4**
(c)	Air flows with a velocity of 360 m/s through a duct. At a particular section of the duct the pressure and the temperature are 85 kPa and 290 K. If flow is isentropic, find (a) Mach number at the given section and (b) Mach number, temperature and velocity at another section where static pressure is 125 kPa.	**8**
9. (a)	A square gate with side dimensions 30 cm is provided in the side wall of a tank which is filled with water of specific weight 9790 N/m^3. The top side of the gate is hinged with the tank. What force P must be applied at the lower end of the gate so as to hold the hinged door closed? The hinged door lies at 3m below the free water surface. What will be the above forces if the water is subjected to a pressure of 50000 N/m^2?	**10+4**
	Explain the differences with example between: I. Uniform and non-uniform flow II. Compressible and incompressible flow	**2 X 3 =6**

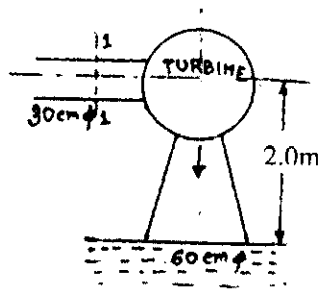

Figure Q 5 (a)