Model Question Paper-1/2 with effect from 2022-23 (CBCS 2022 Scheme)

USN										

Third Semester Aeronautical /Aerospace Engg. B.E. Degree Examination

[Fluid Mechanics]

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

Question No.	Description	Bloom's Taxonomy Level	CO	Marks
	Module 1			
01 (a)	Distinguish between manometers and mechanical gauges. What are the different types of mechanical gauges used explain briefly?	L1	3	8
(b)	Prove that the intensity of pressure at a point in static field is equal in all directions.	L2	1	6
(c)	What are the gauge pressure and absolute pressure at a point 3m below the free surface of liquid having density of $1.53*10^3$ kg/m^3 if the atmospheric pressure is equivalent to 750mm of mercury? The specific gravity of mercury is 13.6 and density of water is $1000kg/m^3$.	L3	2	6
	(OR)			
02 (a)	Prove that the rate of increase of pressure in a vertically downward direction must be equal to the specific weight of fluid at that point.	L2	1	8
(b)	Prove that centre of pressure lies below the centre of gravity of vertically immersed plane surface in a static fluid.	L2	1	8
(c)	A stone weighs 392.4N in air and 196.2N in water. Compute the volume of stone and its specific gravity	L3	2	4
	Module 2			
03(a)	Derive the general three dimensional continuity equation and then reduce it to continuity equation for steady, two dimensional in compressible flow.	L2	1,2	12
(b)	The velocity potential function is given by expression $\phi = -xy^3/3 - x^2 + x^3y/3 + y^2$ i) find the velocity components in x & y directions. ii)show that ϕ represents possible case of fluid flow.	L3	2	8
	(OR)			
04(a)	Derive an expression of energy equation in global form of conservation equation	L2	1,2	10
(b)	Obtain an expression in differential form for navier stokes equations .	L2	1,2	10
	Module 3			

05 (a)	Derive the Euler's equation of motion for steady flow and obtain Bernoulli's equation from it. State the assumptions made in derivation of Bernoulli's equation	L2	1,2	10
(b)	Explain a venturimeter. Derive an expression for discharge. Why venturimeter is better than orifice meter?	L2	1,2	10
	(OR)			
06 (a)	The pressure difference Δp in a pipe of diameter D and length l due to viscous flow depends on the velocity V, viscosity μ and density ρ. Using Buckingham's π- theorem, obtain an expression for Δp.	L3	2	10
(b)	The resisting force R of supersonic plane during flight can be considered as dependent upon the length of the aircraft l, velocity V, air viscosity μ, air density ρ and bulk modulus of air k. express the functional relationship between these variables and resisting force.	L3	2	10
	Module 4			
07 (a)	Derive an expression for a lift force on rotating cylinder which represents kutta- joukowsky equations?	L2	1,2	10
(b)	What are the boundary layer conditions that must be satisfied by a given velocity profile in laminar boundary layer flows.	L2	2	10
	(OR)			
08 (a)	Obtain von karman momentum integral equation.	L2	2	10
(b)	Air flows at 10m/s past a smooth rectangular flat plate 0.3m wide 3m long. Assuming that the turbulence level in the oncoming stream is low and that transition occurs at Re = 5*10^5, calculate ratio of total drag when the flow is parallel to the length of the plate to the value when flow is parallel to width	L3	2	10
	Module 5			
09 (a)	Briefly explain the concept of propagation of disturbances in fluid and derive an expression for velocity of sound.	L2	1,2,3	10
(b)	Show by means of diagrams the nature of propagation of disturbance in compressible flow when mach number is less than one, is equal to one and is more than one.	L3	1,2,3	10
	(OR)			
10(a)	State bernoulli's theorem for compressible flow. Derive an expression for bernoulli's equation when the process is isothermal process	L2	2	10
10(b)	Find the mach number when an aeroplane os flying at 1100km/hr through still air having pressure of 7N/cm^2 and temperature -5^{0}C. wind velocity may be taken as zero. Take R = 287.14J/kgK. Calculate the pressure, temperature and density of air at stagnation point on the nose of the plane. Take k = 1.4	L3	2	10

[BAE303/BAS303]

Model Question Paper-2/2 with effect from 2022-23 (CBCS 2022 Scheme)

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Third Semester Aeronautical /Aerospace Engg. B.E. Degree Examination

[Fluid Mechanics]

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

Question No.	Description	Marks	CO	Bloom's Taxonomy Level
	Module 1			
1 (a)	What is temperature lapse rate? Obtain an expression for temperature lapse rate.	L2	2	8
(b)	Prove that pressure and temperature for an adiabatic process at a height z from sea level for static air are a. $P = P_0 [1-(\frac{k-1}{k}) \frac{gZ}{RT0}]^{k/k-1}$ b. $T = T_0[1-(\frac{k-1}{k}) \frac{gZ}{RT0}]$	L3	2	12
	(OR)			
02 (a)	Give reasons for the following: a. Viscosity changes with temperature rise b. Mercury is preferred in manometer liquid c. Light weight objects can float on the free surface of liquid. d. Free surface of water in capillary tube is concave	L1	1,2	8
(b)	Explain the phenomenon of capillarity. Obtain an expression for capillary rise and capillary fall.	L2	2	8
(c)	Determine the specific gravity of fluid having viscosity $0.005 Ns/m^2$ and kinematic viscosity $0.05*10^{-4}\ m^2/s$.	L3	2	4
	Module 2			
03(a)	A source and a sink of strength $4m^2/s$ and $8m^2/s$ are located at (-1,0) & (1,0) respectively. Determine the velocity and stream function at a point P(1,1) which is lying on the flownet of the resultant streamline.	L3	2	10
(b)	Obtain an equation of stream function & potential function. Draw stream line and potential lines for source flow.	L2	2	6
(c)	Given the velocity field, $V = 5x^3i - 15x^2yj$, obtain the equation for streamlines. For above given velocity field, check for the continuity and irrotationality.	L3	2	4
	(OR)			
04(a)	Obtain an integral form and differential form of energy equation using control volume approach.	L2	2	10

(b)	Derive the Navier stokes equations by control volume approach. Mention the applications of continuity, momentum and energy equations.	L3	2	10
	Module 3			
05 (a)	The inlet and throat diameters of a horizontal venturimeter are 30cm and 10cm respectively. The liquid flowing through the meter is water. The pressure intensity at inlet is $13.734 N/cm^2$ while the vacuum pressure head at the throat is 37cm of mercury. Find the discharge of water through venturimeter. Take C_d=0.98.	L3	2	8
(b)	Find discharge through a trapezoidal notch which is 1m wide at the top and 0.40m at the bottom and 30cm in height. The head of water on the notch is 20cm. Assume Cd for rectangular portion = 0.62 while for triangular portion = 0.6	L3	2	6
(c)	Obtain an expression for discharge over a rectangular notch with neat sketch.	L2	1	6
	(OR)			
06 (a)	Derive on the dimensional analysis suitable parameters to present the thrust developed by a propeller. Assume that the thrust P depends upon the angular velocity ω, speed of advance V, diameter D, dynamic viscosity μ, mass density ρ, elasticity of the fluid medium which can be denoted by the speed of sound in the medium C.	L3	2	10
(b)	A test was made on a pipe model 15mm in diameter and 3m long with water flowing through it at the corresponding speed for frictional resistance. The head loss was found by measurement to be 7m of water. The prototype pipe is 300mm in diameter and 240m long through which air is flowing at 3.6m/s. density of water and air is $1000 kg/m^3$ and $1.22 kg/m^3$respectively and coefficients of viscosity of water and air are 0.01 & 0.00018 poise. find i) the corresponding speed of water in the model pipe for dynamic similarity. ii) pressure drop in the prototype.	L3	2	10
	Module 4			
07 (a)	For the velocity profile for laminar boundary flow $\frac{u}{U} = \sin[\frac{\pi y}{2\delta}]$. Obtain an expression for boundary layer thickness, shear stress, drag force on one side of the plate and coefficient of drag in terms of Reynolds number	L2	2	10
(b)	For velocity profile for turbulent boundary layer $\frac{u}{U} = [\frac{y}{\delta}]^{(1/7)}$, obtain an expression for boundary layer thickness, shear stress, drag force on one side of the plate and coefficient of drag in terms of Reynolds number. Given $\tau_0 = 0.0225\rho U^2[\frac{\mu}{\rho\delta U}]^{(1/4)}$	L2	2	10
	(OR)			
08 (a)	Define and obtain expression for:	L2	1,2	10

	i) displacement thickness ii) momentum thickness iii) energy thickness			
(b)	Consider two different points on the surface of the airplane wing flying at 80m/s. the pressure coefficient and flow velocity at point 1 are -1.5 and 110m/s, respectively. The pressure coefficient at point 2 is -0.8. assuming incompressible flow, calculate the flow velocity at point 2	L3	2	6
(c)	With neat sketch, explain the airfoil characteristics.	L1	2	4
Module 5				
09 (a)	Derive an expression for the velocity of sound wave for compressible fluid when process is assumed as i) isothermal & ii) adiabatic.	L2	2	10
(b)	Calculate the stagnation pressure, temperature and density on the stagnation point on the nose of a plane, which is flying at 800km/hr. through still air having pressure 8N/cm^2(abs), temperature -10^{o}C. Take R = 287.14J/Kg K and k = 1.4	L3	2	10
(OR)				
10(a)	Derive an expression for stagnation pressure, temperature and density for compressible flow.	L2	2	15
10(b)	Find the velocity of bullet fired in standard air if the mach angle is 30^o. Take R = 287.14J/kg K and K = 1.4 for air. Assume temperature as 15^{o}C.	L3	2	5