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B.Tech DEGREE EXAMINATION, DECEMBER 2023

Fifth Semester

18ASE201T - INDUSTRIAL AERODYNAMICS

(For the candidates admitted during the academic year (2020-2021 & 2021-20222))

Note:

i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours **Max. Marks: 100**

PART - A (20 × 1 = 20 Marks) — Answer **all** Questions

		Marks	BL	CO
1.	Atmospheric turbulence intensity is the measure of (A) mean wind speed (B) fluctuations in wind speed (C) humidity in the wind (D) wind temperature variations	1	1	1
2.	Wind from Land to Sea is called as (A) Sea Breeze (B) Land Breeze (C) Air Breeze (D) Thermal Breeze	1	1	1
3.	The pseudo force that acts because of earth's rotation is called (A) Drag force (B) Lift force (C) Coriolis force (D) Gravitational force	1	1	1
4.	Which terrain has a high aerodynamic roughness length? (A) Open sea (B) Forest (C) Ice (D) City center	1	1	1
5.	Which of the following wind turbines has higher C_p value? (A) Savonius WT (B) Darrieus WT (C) Three bladed HAWT (D) American multi-bladed WT	1	1	2
6.	The available power (P) at any wind site depends on the local wind speed (V) as (A) $P \alpha V$ (B) $P \alpha V^2$ (C) $P \alpha V^3$ (D) $P \alpha V^{0.5}$	1	1	2
7.	Which of the following is not considered for deriving the Betz limit for a wind turbine? (A) Wind speed (B) Wind turbine diameter (C) air density (D) number of blades	1	1	2
8.	The yaw drive in a wind turbine is used for (A) aligning all the wind turbines in same direction (B) aligning the wind turbine to face the wind direction (C) aligning the wind turbine to face east (D) aligning the wind turbine perpendicular to the wind direction	1	1	2
9.	Flow separation on a vehicle is due to (A) Favorable pressure gradient (B) Adverse pressure gradient (C) Zero pressure gradient (D) Fluctuating pressure gradient	1	1	3
10.	The simplest model to study Car Aerodynamics is (A) Akbar model (B) Ahmed model (C) ARAI model (D) F1 model	1	1	3

11.	Drag coefficient is high for (A) Sedan (B) SUV (C) Hatchback (D) Wagon	1	1	3
12.	. The lift and drag coefficients of a car are high when the cut-back angle (or rear surface slantness) is (A) θ=10 deg. (B) θ=20 deg. (C) θ=30 deg. (D) θ=40 deg.	1	1	3
13.	Galloping occurs for flow (A) Inside a pipe (B) over a cylinder (C) over a flat plate (D) inside a channel	1	1	4
14.	Flow over a circular cylinder at Re=30 shows (A) Vortex shedding (B) Creeping flow (C) Turbulent wake (D) Recirculation	1	1	4
15.	Reynolds number is the ratio of (A) viscous to buoyancy forces (B) inertial to viscous forces (C) inertial to buoyancy forces (D) laminar to turbulent forces	1	1	4
16.	Which of the following is true for flow over smooth and rough spheres? (A) smooth sphere has less form drag (B) rough sphere has less form drag (C) both smooth and rough spheres will have same form drag (D) form drag will be zero for smooth sphere	1	1	4
17.	The wind loads in low-rise buildings are primarily due to (A) vortex shedding (B) roof suction (C) corner vortices (D) vortex induced vibrations	1	1	5
18.	In building ventilation, stack effect arises due to (A) Buoyancy (B) Turbulence (C) Gusts (D) Blowers	1	1	5
19.	A tall building of length 100 m and width 10 m is found to oscillate at a frequency of 5 Hz in a wind speed 20 m/s. Its Strouhal number is (A) 10 (B) 2.5 (C) 25 (D) 40	1	1	5
20.	Helical strake around a tall chimney is used to suppress (A) Boundary layer (B) Vortex induced vibrations (C) Turbulence (D) Gusts	1	1	5

PART - B (5 × 4 = 20 Marks)

Answer **any 5** Questions

		Marks	BL	CO
21.	Write power-law and logarithmic-law that are used to represent an atmospheric boundary layer.	4	2	1
22.	Define power coefficient, tip speed ratio and solidity ratio of a wind turbine. Write their formulae.	4	2	2
23.	Sketch the pressure distribution (Cp) over a generic car model. Mark the possible regions of flow separation.	4	2	3
24.	Define stall flutter and galloping flutter	4	2	4
25.	Explain TVL formula and Funneling effect.	4	2	5
26.	What is Ahmed body? Explain its significance	4	2	3
27.	List the advantages and disadvantages of Horizontal Axis Wind Turbines.	4	2	2

PART - C (5 × 12 = 60 Marks)

Answer **all** Questions

		Marks	BL	CO

28.	(a) (i) Explain the evolution of atmospheric boundary layer over the course of a day. [6 Marks] (ii) Discuss the effect of terrain on the mean velocity profile of the atmospheric boundary layer. [6 Marks] **(OR)** (b) With a neat sketch, explain how the atmospheric boundary layer is simulated in a wind tunnel.	12	2	1
29.	(a) (i) Obtain the power coefficient of wind turbine which is a drag translator device. [6 Marks] (ii) Discuss in detail the airfoil selection for wind turbines. [6 Marks] **(OR)** (b) Obtain the Betz limit for the maximum power coefficient of an ideal wind turbine. State all the assumptions involved.	12	3	2
30.	(a) With suitable sketches, discuss the effects of adding a (i) rear spoiler and (ii) rear wing to a car. **(OR)** (b) With suitable sketches, discuss in detail the various methods for generating downforce in a car.	12	3	3
31.	(a) Explain the following w.r.t the aerodynamics of a cricket ball with sketches (i) Swing and (ii) Spin **(OR)** (b) With necessary sketches, discuss the various methods to control the vortex induced vibrations of a cylinder.	12	3	4
32.	(a) With neat sketches of streamline patterns, explain the flow past a low-rise building (cuboid shape). **(OR)** (b) Discuss the wind loads acting on the launch vehicles.	12	3	5

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