

# PGCET-2023

Seat No. \_\_\_\_\_

SUB: Aerospace Engineering

Time: 1 Hour 30 minutes

## Instructions:

1. Ensure that all pages are printed.
2. Use Black ball pen only
3. Change in option is not allowed
4. There is no negative marking
5. Use of non-programmable scientific calculator is allowed

1.	The drag of an aircraft in steady climbing flight at a given forward speed is			
	A	independent of climb angle	B	lower than drag in steady level flight at the same forward speed
	C	higher than drag in steady level flight at the same forward speed	D	inversely proportional to climb angle
2.	The combustion process in a turbo-shaft engine during ideal operation is			
	A	Isothermal	B	isobaric
	C	Isochoric	D	isentropic
3.	The best estimate of whether the flow is compressible or not comes from			
	A	Compressibility values	B	Pressure
	C	Mach number	D	Velocity
4.	Corner speed is defined as			
	A	maximum drag velocity	B	maximum lift velocity
	C	velocity for maximum instantaneous turn	D	minimum instantaneous turn speed
5.	The Joukowski airfoil is studied in aerodynamics because			
	A	it is used in many aircrafts	B	it is easily transformed into a circle, mathematically
	C	it has a simple geometry	D	it can easily manufactured
6.	The aerodynamic centre of a supersonic airfoil, with chord $c$ , is located at			
	A	$0.5c$	B	$1.0c$
	C	$0.25c$	D	$0.75c$

7.	Velocity gradients in turbulent boundary layer are			
	A	lower compared to laminar boundary layer	B	higher compared to laminar boundary layer
	C	higher than laminar boundary layer in favourable pressure gradient, but lower in adverse pressure gradient regime	D	lower than laminar boundary layer in favourable pressure gradient, but higher in adverse pressure gradient regime
8.	A transport aircraft's service ceiling is determined by its altitude			
	A	at which it can cruise with one engine operational	B	that is halfway between sea-level and absolute ceiling
	C	at which its maximum rate of climb is 0.508 m/s	D	at which its maximum rate of climb is 0 m/s
9.	The velocity required for a spacecraft to escape earth's gravitational field depends on			
	A	The distance between earth's centre and the spacecraft	B	The mass of the spacecraft
	C	The earth's rotational speed about its own axis	D	The earth orbital speed
10.	During level turning operation an aircraft has load factor of 2. The required bank angle for this level turning operation is			
	A	120°	B	60°
	C	120 rad	D	60 rad
11.	Indicated air speed is used by a pilot during			
	A	take-off	B	navigation
	C	Landing	D	setting the elevator angle
12.	With increase in airfoil thickness, the critical Mach number for an airfoil is likely to			
	A	Decrease	B	increase
	C	remain unchanged	D	be undefined
13.	Which one of the following is favourable for an airplane operation?			
	A	Tail wind both in cruise and landing	B	Tail wind in cruise and head wind in landing
	C	Head wind both in cruise and landing	D	Head wind in cruise and tail wind in landing

14.	What does Kepler's law of period relate?			
	A	Time period and semi-minor axis	B	Time period and eccentricity
	C	Time period and semi-major axis	D	Time period and area swept by the planet
15.	An irrotational and inviscid flow can become rotational on passing through a			
	A	normal shock wave	B	oblique shock wave
	C	curved shock wave	D	March wave
16.	Which of the following can result in an increase in the Mach number of a supersonic flow in a duct ?			
	A	adding heat to the flow	B	removing heat from the flow
	C	increasing the length of the duct	D	decreasing the length of the duct
17.	Aerodynamic forces are generated due to _____			
	A	shear effects only	B	shear and pressure force acting on body
	C	only pressure forces	D	lift and drag forces
18.	Which of the following is true for isentropic flow ?			
	A	Enthalpy = 0	B	Pressure = 0
	C	Entropy = 0	D	Temperature = 0
19.	Which of the following airfoil sections is an appropriate candidate for a vertical tail?			
	A	NACA 0012	B	NACA 2312
	C	NACA 23012	D	Clarke Y Profile
20.	The sum of natural frequencies of an elastic beam with cantilever boundary conditions is			
	A	1	B	0
	C	Infinite	D	Depends upon the load
21.	For a plane strain problem in the x-y plane, in general, the non-zero stress terms are			
	A	$\sigma_{xx}, \sigma_{yy}, \sigma_{xy}, \sigma_{zz}$	B	$\sigma_{zz}, \sigma_{xz}, \sigma_{yz}, \sigma_{xy}$
	C	$\sigma_{yy}, \sigma_{xz}, \sigma_{yz}, \sigma_{xy}$	D	$\sigma_{xx}, \sigma_{xy}, \sigma_{yy}, \sigma_{xz}$

22.	What material is used for aircraft fuselage?			
	A	High carbon steels	B	Stainless Steel
	C	Aluminum alloy	D	Nickel alloy
23.	A cantilever with thin-walled channel cross-section is subjected to a lateral force at its shear centre. The cantilever undergoes			
	A	bending without twisting	B	neither bending nor twisting
	C	bending and twisting	D	twisting without bending
24.	An artificial satellite remains in orbit and does not fall to earth because			
	A	The on-board rocket motor provide continuous boost to keep it in orbit.	B	Due to its high speed, it derives sufficient lift from the rarefied atmosphere.
	C	It's transverse velocity keeps it from hitting the earth although it falls continuously	D	The centrifugal force acting on it balances the gravitational attraction
25.	Consider the vertical velocity of the aircraft is 10m/s and horizontal velocity is 12 m/s. Determine the value of climb gradient.			
	A	1.89	B	0.833
	C	2.483	D	8
26.	For a given chamber pressure, the thrust of a rocket engine is highest when			
	A	the rocket is operating at its design altitude	B	there is a normal shock in the rocket nozzle
	C	the rocket is operating at sea-level	D	the rocket is operating in vacuum
27	For a circular trajectory of a satellite around the earth, the centrifugal forces must balance the _____			
	A	propulsive forces	B	gravitational forces
	C	lift forces	D	drag forces
28	An aircraft weighing 250kg is in level turning operation. Find the value of vertical component of lift.			
	A	250N	B	2.452KN
	C	0.5KN	D	5KN

29	Satellite velocity is maximum at _____ for an elliptical orbit.			
	A	Apogee	B	focal point
	C	Perigee	D	infinity
30	Why does the landing gear retract into the wings and/or fuselage during flight?			
	A	To increase airspeed	B	To decrease airspeed
	C	To decrease drag	D	To generate more thrust
31	Which of these equations are needed for compressible flows?			
	A	Mass and momentum conservations and equation of state	B	Momentum and energy conservations and equation of state
	C	Mass, momentum and energy conservations	D	Mass, momentum and energy conservations and equation of state
32	For a flow across an oblique shock which of the following statements is true?			
	A	Component of velocity normal to shock decreases while tangential component increases.	B	Component of velocity normal to shock is unchanged while tangential component decreases.
	C	Component of velocity normal to shock increases while tangential component decreases.	D	Component of velocity normal to shock decreases while tangential component is unchanged.
33	Which of the following is not true about an airframe made with carbon-fiber composite?			
	A	Decreases drag	B	Decreases thrust
	C	Higher cabin pressurization	D	Higher wing aspect ratio
34	The Poisson's ratio $\nu$ of most aircraft grade metallic alloys has values in the range			
	A	$-1 \leq \nu \leq 0$	B	$0 \leq \nu \leq 0.2$
	C	$0.2 \leq \nu \leq 0.4$	D	$0.4 \leq \nu \leq 0.5$
35	The Prandtl Number approximates _____			
	A	Momentum diffusivity to thermal diffusivity	B	Shear stress to thermal diffusivity
	C	Thermal diffusivity to momentum diffusivity	D	Thermal diffusivity to kinematic viscosity

36	Which one of the following materials should be selected to design an axial flow turbine operating at high temperatures?			
	A	High carbon steels	B	Stainless Steel
	C	Aluminum alloy	D	Nickel alloy
37	Turn rate is defined as			
	A	ratio of lift to drag	B	product of thrust and velocity
	C	ratio of radial acceleration and the velocity	D	ratio of drag to lift
38	An Euler-Bernoulli beam in bending is assumed to satisfy			
	A	both plane stress as well as plane strain conditions	B	plane strain condition but not plane stress condition
	C	plane stress condition but not plane strain condition	D	neither plane strain condition nor plane stress condition
39	In an aircraft, the dive manoeuvre can be initiated by			
	A	reducing the engine thrust alone.	B	reducing the angle of attack alone.
	C	generating a nose down pitch rate.	D	increasing the engine thrust alone
40	The parameters that remain constant in a cruise-climb of an aircraft are			
	A	equivalent airspeed and lift coefficient	B	equivalent airspeed and altitude
	C	lift coefficient and aircraft mass	D	altitude and lift coefficient
41	In an elliptic orbit around any planet, the location at which a spacecraft has the maximum angular velocity is			
	A	Apoapsis	B	periapsis
	C	a point at $45^\circ$ from periapsis	D	a point at $-90^\circ$ from apoapsis
42	Which among the following is an assumption of the compressible flow?			
	A	No-slip condition	B	Resistance to flow of object
	C	Known mass flow rate	D	Resistance to flow of heat
43	What amongst the following is not true for normal shock wave?			
	A	Normal shock wave has velocity and pressure gradients	B	Shock wave is pretty thick
	C	Entropy increases across normal shock wave	D	Presence of thermal and frictional dissipation

44	When a body is subjected to transverse vibrations, the stress induced in a body will be			
	A	shear stress	B	tensile stress
	C	compressive stress	D	none of the mentioned
45	Mohr's Circle represents_____			
	A	the endurance limit to fatigue failure	B	the area of multiple circles
	C	the state of stress at a point on an oblique plane	D	the lattice planes of the crystal
46	Euler's equation is valid for			
	A	compressible as well as incompressible inviscid flow	B	viscous or inviscid incompressible flow
	C	inviscid incompressible flow only	D	potential flow only
47	In a spring-mass-damper single degree of freedom system, the mass is 2 kg and the undamped natural frequency is 20 Hz. The critical damping constant of the system is			
	A	$80\pi$ N.s/m	B	$160\pi$ N.s/m
	C	0N.s/m	D	$100\pi$ N.s/m
48	On which of the following thermodynamic cycles does an ideal ramjet operate?			
	A	The Brayton cycle	B	The Carnot cycle
	C	The Otto cycle	D	The Rankine cycle
49	The degree of reaction of an impulse turbine is			
	A	1	B	0.75
	C	0.5	D	0
50	The pitch angle and the angle of attack for a fixed wing aircraft are equal during			
	A	unaccelerated climb	B	unaccelerated descent
	C	Landing	D	wings level constant altitude flight
51	During an aircraft cruising flight, the altitude above the ground is usually measured using			
	A	dynamic pressure	B	static pressure
	C	radar	D	laser range finder

52	Which one of the following engines should be used by a subsonic passenger transport airplane for minimum specific fuel consumption?			
	A	Ramjet engine	B	Turbojet engine with afterburner
	C	Scramjet engine	D	Turbofan engine
53	When there is a reduction in amplitude over every cycle of vibration, then the body is said to have			
	A	free vibration	B	damped vibration
	C	forced vibration	D	none of the mentioned
54	With increase in airfoil thickness, the critical Mach number for an airfoil is likely to			
	A	Increase	B	Decrease
	C	remain unchanged	D	be undefined
55	The Rayleigh Pitot tube formula does not relate which of these quantities to the others?			
	A	Free-stream static pressure	B	Free-stream Mach number
	C	Pitot pressure	D	Upstream flow velocity
56	What is the thrust of an engine if the inlet and exhaust mass flow rates are 150 kg/s and 190 kg/s respectively with the pressure difference between the exhaust and ambient air is $1.85 \times 10^4$ ? The exhaust area is $2\text{m}^2$ , the ambient and exhaust velocities are 280 m/s and 400 m/s.			
	A	50 kN	B	62 kN
	C	71 kN	D	84 kN
57	The purpose of a fuel injection system in the combustor is			
	A	to accelerate the flow in the combustor	B	to increase the stagnation pressure of the fuel- air mixture nation press
	C	to convert the bulk fuel into tiny droplets	D	to ignite the fuel-air mixture
58	How does the specific thrust of a turbojet engine change for a given flight speed with increase in flight altitude?			
	A	Increases monotonically	B	Decreases monotonically
	C	Remains constant	D	First increases and then decreases



59	A conventional altimeter is a			
	A	Density transducer	B	Temperature transducer
	C	Velocity transducer	D	Pressure transducer
60	Which of the following airfoils will have location of the maximum camber at half chord length from the leading edge ?			
	A	NACA 5212	B	NACA 1225
	C	NACA 2215	D	NACA 2512
61	Which of the following statements is true about the effect of increase in temperature on dynamic viscosity of water and air, at room temperature?			
	A	It decreases for water and increases for air.	B	It increases for both water and air.
	C	It increases for water and decreases for air.	D	It decreases for both water and air.
62	In an ideal gas turbine cycle, the expansion in a turbine is represented by			
	A	an isenthalpic process	B	an isentropic process
	C	an isochoric process	D	an isobaric process
63	The Mach angle for a flow at Mach 2.0 is			
	A	45°	B	60°
	C	30°	D	90°
64	The first law of thermodynamics is also known as conservation of			
	A	Mass	B	Momentum
	C	Energy	D	Pressure
65	Which of the following aircraft engines has the highest propulsive efficiency at a cruising Mach number of less than 0.5?			
	A	Turbojet engine	B	Turbofan engine
	C	Turboprop engine	D	Ramjet engine
66	An impulsive launch of a rocket minimizes the loss of burn-out velocity due to			
	A	reaction jet control force	B	aerodynamic drag force only
	C	both aerodynamic drag and gravitational forces	D	gravitational force only

67	Which of the following remains constant across a centrifugal compressor ?			
	A	Total enthalpy	B	Static enthalpy
	C	Total pressure	D	Rothalpy
68	Which of the following doesn't appear in Navier stokes momentum equations?			
	A	Body forces	B	Pressure
	C	Shear stress due to viscosity	D	Internal energy
69	The second law of Kepler stating constancy of aerial velocity of a planet is a consequence of the law of Conservation of			
	A	Energy	B	angular momentum
	C	linear momentum	D	none of these
70	What is responsible for creating the aerodynamic drag on the airfoil?			
	A	Friction	B	Thrust
	C	Gravity	D	Pressure distribution
71	Multi-staging in rockets improves the burn-out performance by increasing mainly stage-wise			
	A	payload mass ratios	B	structural mass efficiencies
	C	propellant masses	D	control system masses
72	Total pressure at a point is defined as the pressure when the flow is brought to rest			
	A	isobarically	B	Isothermally
	C	isentropically	D	Adiabatically
73	If an aircraft is performing a positive yawing manoeuvre, the side slip angle			
	A	is never zero	B	is always zero
	C	is always negative	D	is always positive
74	The life of a geostationary communication satellite is limited by			
	A	The working life of the on-board electronic circuitry	B	The time it takes for its orbit to decay due to atmospheric drag
	C	The quantity of on-board fuel available for station keeping	D	The number of meteorite impacts that the satellite structure can withstand before breaking up

75	Two pipes of constant sections but different diameters carry water at the same volume flow rate. The Reynolds number, based on the pipe diameter, is			
	A	the same in both pipes	B	is smaller in the narrower pipe
	C	is larger in the narrower pipe	D	depends on the material of the pipes
76	In a scramjet engine, the Mach number at the entry to the combustion chamber is around			
	A	0	B	2
	C	0.3	D	6
77	Navier stokes equations without considering viscosity turn are called			
	A	Lagrange equations	B	Helmholtz equations
	C	Eulers equations	D	Newton's equations
78	Which of these conditions is essential for a rotor airfoil when the helicopter has high forward speed?			
	A	Low critical Mach number	B	High critical Mach number
	C	Low drag divergence	D	High angle of attack
79	Prandtl – Glauert compressibility correction is based on which of the following methods?			
	A	Velocity potential equation	B	Energy equation
	C	Momentum equation	D	Continuity equation
80	Which nozzle is used in supersonic wind tunnel?			
	A	Divergent	B	Convergent
	C	Conical	D	Convergent – Divergent
81.	The probability for an Impossible event is ____.			
	A	0	B	1
	C	Between 0 and 1	D	Not defined
82.	A bag has 4 Red balls and 6 White balls. If we take a ball from the bag, then what is the probability of getting white ball only?			
	A	6	B	3/2
	C	3/5	D	2/5

83.	In a Binomial distribution, if there are 40 trials and the probability of success is 0.2, then the value of the mean is ____.			
	A	6.4	B	8
	C	32	D	0.16
84.	Rate of convergence for the Regula – Falsi method is ____.			
	A	1.1321	B	2.312
	C	1.618	D	2.231
85.	Which of the following is Eigen value for the matrix $A = \begin{bmatrix} 1 & 8 \\ 2 & 1 \end{bmatrix}$ .			
	A	7	B	5
	C	3	D	1
86.	Which of the following function $f(z)$ , of complex variable $z$ , is NOT analytic?			
	A	$f(z) = z^2$	B	$f(z) = e^z$
	C	$f(z) = \sin z$	D	$f(z) = \log z$
87.	The value of the integral $\int_{-\infty}^{\infty} \frac{1}{1+x^2} dx$ is ____.			
	A	$\pi$	B	$-\pi/2$
	C	$\pi/2$	D	$-\pi$
88.	The solution of the differential equation $\frac{dy}{dx} + 4y = 5$ with $y(0) = 2.25$ is ____			
	A	$y = e^{4x} + 5$	B	$y = e^{4x} + 1.25$
	C	$y = e^{-4x} + 5$	D	$y = e^{-4x} + 1.25$
89.	The divergence of the vector field $3xz\mathbf{i} + 2xy\mathbf{j} - yz^2\mathbf{k}$ at point $(1,1,1)$ is ____.			
	A	7	B	4
	C	3	D	0
90.	Using trapezoidal rule, and dividing the interval of integral into three subintervals, the definite integral $\int_{-1}^1  x  dx$ is ____			
	A	1.00	B	1.11
	C	1.31	D	1.51
91.	Laplace Transform of $t^4 e^{-at}$ is ____			
	A	$\frac{4!}{(s+a)^4}$	B	$\frac{5!}{(s+a)^4}$
	C	$\frac{4!}{(s+a)^5}$	D	$\frac{5!}{(s+a)^5}$

92.	Inverse Laplace transform of $\frac{1}{s(s+2)}$ is _____.			
	A	$\frac{1-e^{2t}}{2}$	B	$\frac{1-e^{-2t}}{2}$
	C	$\frac{1+e^{2t}}{2}$	D	$\frac{1+e^{-2t}}{2}$
93.	The complementary function of the differential equation $(D^3 + 2D^2 + D)y = x^2$ is _____.			
	A	$y = c_1 + (c_2x + c_3)e^{-x}$	B	$y = c_1 + (c_2x + c_3)e^{2x}$
	C	$y = c_1 + (c_2x + c_3)e^x$	D	None of these
94.	Determine the second derivative of the function $f(x) = x^2 \ln 2x$ .			
	A	$2 \ln 2x + 3$	B	$2 \ln 2x + \frac{3}{2}$
	C	0	D	None of these
95.	The integral $\int_e^\infty \frac{1}{x(\ln x)^2} dx$ is _____			
	A	Divergent	B	0
	C	-1	D	1
96.	If $x = r \cos \theta$ , $y = r \sin \theta$ then find $\frac{\partial(x, y)}{\partial(r, \theta)} =$ _____			
	A	0	B	$r$
	C	1	D	$1/r$
97.	Which of the following statements are true in general? Statement 1: Singular matrix is always a square matrix. Statement 2: Every square matrix is symmetric matrix. Statement 3: Every square matrix satisfies its own characteristic equation.			
	A	Only statement 1	B	Statement 1 and 2
	C	Statement 1 and 3	D	All of above
98.	The probability density function of Poisson distribution is given by _____			
	A	$\frac{e^{-m} m^x}{x!}$	B	$\frac{e^m m^x}{x!}$
	C	$\frac{e^m x^m}{m!}$	D	$\frac{e^{-m} x^m}{m!}$
99.	Which of the following method is used to find solution of Ordinary Differential Equation?			
	A	Bisection Method	B	Newton Raphson method
	C	Successive approximation method	D	Euler's method
100	If $f(x, y, z) = x^2 + xyz + z$ , then find $f_x(1, 1, 1)$ .			
	A	0	B	1
	C	-1	D	3