AOT308	COMPREHENSIVE COURSE WORK	CATEGORY	L	T	P	CREDIT
		PCC	1	0	0	1

Preamble: Objective of this course is to assess the comprehensive knowledge gained in core courses relevant to the branch of study. Also, to comprehend the application/practical oriented questions asked and answer them with confidence.

Prerequisite: Aerodynamics, Aircraft structures, Aircraft propulsion, Flight mechanics, Avionics systems and instruments.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply the theories and techniques used in aerodynamics.
CO 2	Analyse the design concepts and methods used in aircraft structures.
CO 3	Apply the concepts and working principles used in aircraft propulsion.
CO 4	Analyse the stability and various maneuvering used in flight mechanics.
CO 5	Apply the design and working principles of various avionics systems and instruments.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	-	-	-	-	-	-	-	-	-
CO 2	3	2	1	-	-	-	-	-	-	-	-	-
CO 3	3	2	1	-	-	-	-	-	-	-	-	-
CO 4	3	2	1	-	-	-	-	-	-	-	-	-
CO 5	3	2	1	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Test (ORAL EXAM)	End Semester Examination (WRITTEN EXAM)
Remember		
Understand		
Apply	30	30
Analyse	20	20
Evaluate		
Create		

<u>Assessment</u>

Oral examination – To be conducted by the college (@ three students/hour) covering all the courses up to and including V semester – 50 marks

Written examination - To be conducted by the Dept. on the date announced by the University– common to all students of the same branch – objective type (1.5-hour duration)– 50 multiple choice questions (4 choices) of 1 mark each covering the five modules as per mentioned in the syllabus. Questions are set by the University - no

negative marks – 50 marks.

Note: Both oral and written examinations are mandatory. But separate minimum marks are not insisted for pass. If a student does not complete any of the two assessments, grade I shall be awarded and the final grade shall be given only after the completion of both the assessments. The two hours allotted for the course may be used by the students for discussion, practice and for oral assessment.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1) Which of the following airfoil 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

2) An ideal fluid is a
   a) One which obeys Newton's law of viscosity.
   b) Frictionless and incompressible.
   c) Very viscous.
   d) Frictionless and compressible

Course Outcome 2 (CO2):

1) A material can return to normal after it has been deformed due to its elasticity.
   a) True
   b) (B) False
   c) Cannot determine
   d) Partially correct

2) Poisson's ratio is defined as the ratio of
   a) longitudinal stress and longitudinal strain
   b) longitudinal stress and lateral stress
   c) lateral stress and longitudinal stress
   d) lateral stress and lateral strain

Course Outcome 3 (CO3):

1) Combustion in gas turbine engines is ideally represented as the following process:
   a) Adiabatic
   b) Isentropic
   c) Isobaric
   d) Isochoric

2) The pressure ratio in any one stage of a jet engine compressor is limited by
   a) Entry stagnation temperature in that stage

b) entry Mach number in that stage
c) Pressure gradient induced separation in that stage
d) mass flow rate in that stage

Course Outcome 4 (CO4):

1) Lift on an aircraft climbing vertically up is
   a) equal to its weight
   b) zero
   c) equal to the drag
   d) equal to the thrust

2) For an airplane to be statically stable, its centre of gravity must always be
   a) ahead of wing aerodynamic centre
   b) aft of the wing aerodynamic centre
   c) ahead of neutral point
   d) aft of neutral point

Course Outcome 5 (CO5):

1) Which of the following instruments are works on the basis of pitot-static system?
   a) Air speed indicator
   b) Altimeter
   c) Vertical speed indicator
   d) Turn and slip indicator

2) Which one of the following flight instruments is used on an aircraft to determine its attitude in flight?
   a) Vertical speed indicator
   b) Altimeter
   c) Artificial Horizon
   d) Turn-bank indicator

Model Question paper

QP CODE: **Reg No: _____**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AOT308

COMPREHENSIVE COURSE WORK

Max. Marks: 50 **Duration: 1.5 hours**

Answer all questions
(Each question carries 1 mark)

1) Which of the following airfoil 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

2) Which one of the following flight instruments is used on an aircraft to determine its attitude in flight?
   a) Vertical speed indicator
   b) Altimeter
   c) Artificial Horizon
   d) Turn-bank indicator

3) In an aircraft, elevator control effectiveness determines
   a) Turn radius.
   b) forward-most location of the centre of gravity.
   c) Rate of climb.
   d) aft-most location of the centre of gravity.

4) Winglets are used on wings to minimize
   a) skin friction drag
   b) profile drag
   c) wave drag
   d) induced drag

5) A conventional altimeter is
   a) Pressure transducer
   b) Temperature transducer
   c) Density transducer
   d) Velocity transducer

6) Lift on an aircraft climbing vertically up is
   a) equal to its weight
   b) zero

c) equal to the drag
d) equal to the thrust

7) For an airplane to be statically stable, its centre of gravity must always be
a) ahead of wing aerodynamic centre
b) aft of the wing aerodynamic centre
c) ahead of neutral point
d) aft of neutral point

8) During the ground roll manoeuvre of an aircraft, the force(s) acting on it parallel to the direction of motion
a) is thrust alone.
b) is drag alone.
c) are both thrust and drag.
d) are thrust, drag and a part of both weight and lift.

9) Which one of the following is the most stable configuration of an airplane in roll?
a) Sweep back, anhedral and low wing
b) Sweep forward, dihedral and low wing
c) Sweep forward, anhedral and high wing
d) Sweep back, dihedral and high wing

10) A supersonic airplane is expected to fly at both subsonic and supersonic speeds during its whole flight course. Which one of the following statements is TRUE?
a) Airplane will experience less stability in pitch at supersonic speeds than at subsonic speeds
b) Airplane will feel no change in pitch stability
c) Airplane will experience more stability in pitch at supersonic speeds than at subsonic speeds
d) Pitch stability cannot be inferred from the information given

11) Which one of the following is favorable for an airplane operation?
a) Tail wind in cruise and head wind in landing
b) Tail wind both in cruise and landing
c) Head wind both in cruise and landing
d) Head wind in cruise and tail wind in landing

12) Which one of the following is TRUE with respect to Phugoid mode of an aircraft?
a) Frequency is directly proportional to flight speed
b) Frequency is inversely proportional to flight speed
c) Frequency is directly proportional to the square root of flight speed
d) Frequency is inversely proportional to the square root of flight speed

13) Which one of the following criteria leads to maximum turn rate and minimum radius in a level turn flight?
a) Highest possible load factor and highest possible velocity
b) Lowest possible load factor and lowest possible velocity
c) Highest possible load factor and lowest possible velocity

d) Lowest possible load factor and highest possible velocity

14) An aircraft in trimmed condition has zero pitching moment at
a) its aerodynamic centre.
b) its centre of gravity.
c) 25% of its mean aerodynamic chord.
d) 50% of its wing root chord

15) In an aircraft, constant roll rate can be produced using ailerons by applying
a) a step input.
b) a ramp input.
c) a sinusoidal input.
d) an impulse input.

16) Bernoulli's equation is valid under steady state
a) only along a streamline in inviscid flow, and between any two points in potential flow.
b) between any two points in both inviscid flow and potential flow.
c) between any two points in inviscid flow, and only along a streamline in potential flow.
d) only along a streamline in both inviscid flow and potential flow.

17) Thin airfoil theory predicts that the lift slope is $CL = 2\pi\alpha$ for
a) Symmetric airfoils only
b) Cambered airfoils only
c) Joukowski airfoils only
d) Any airfoil shape

18) A student can measure free stream velocity of a low speed wind tunnel using a,
(i) Pitot tube alone aligned with the flow direction.
(ii) Pitot tube aligned with the flow direction with static pressure measurement at an appropriate position on the tunnel wall.
(iii) Pitot tube aligned with the flow direction along with barometer pressure reading of the outside ambient.
(iv) Pitot static tube alone aligned with the flow direction.
Considering the above statements, which of the following options is correct?
a) (i) only
b) (i) & (ii)
c) (ii) & (iv)
d) (i), (iii) & (iv)

19) An ideal fluid is a
a) One which obeys Newton's law of viscosity.
b) Frictionless and incompressible.
c) Very viscous.
d) Frictionless and compressible

20) The Joukowski airfoil is studied in aerodynamics because
   a) It is used in many aircrafts.
   b) It is easily transformed into circle mathematically
   c) It has simple geometry
   d) It has the highest lift curve slope among all airfoils

21) A turbulent boundary layer remains attached over a longer distance on the upper surface of an airfoil than does a laminar boundary layer, because
   a) The turbulent boundary layer is more energetic and hence can overcome the adverse pressure gradient better
   b) The laminar boundary layer develops more skin friction and hence slows down more rapidly
   c) Turbulence causes the effective coefficient of viscosity to reduce, resulting in less loss of momentum in the boundary layer
   d) The turbulent boundary layer is thicker, hence the velocity gradients in it are smaller, therefore viscous losses are less.

22) Which one of the following statements is NOT TRUE for a supersonic flow?
   a) Over a gradual expansion, entropy remains constant
   b) Over a sharp expansion corner, entropy can increase
   c) Over a gradual compression, entropy can remain constant
   d) Over a sharp compression corner, entropy increases

23) The Critical Mach number of an airfoil is attained when
   a) the freestream Mach number is sonic.
   b) the freestream Mach number is supersonic.
   c) the Mach number somewhere on the airfoil is unity.
   d) the Mach number everywhere on the airfoil is supersonic

24) 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

25) Which of the following statement is NOT TRUE across an oblique shock wave?
   a) Static temperature increases, total temperature remains constant.
   b) Static pressure increases, static temperature increases.
   c) Static temperature increases, total pressure decreases.
   d) Static pressure increases, total temperature decreases

26) For a completely subsonic isentropic flow through a convergent nozzle, which of the following statement is TRUE?

a) Pressure at the nozzle exit > back pressure.
b) Pressure at the nozzle exit < back pressure.
c) Pressure at the nozzle exit = back pressure.
d) Pressure at the nozzle exit = total pressure.

27) In a closed-circuit supersonic wind tunnel, the convergent-divergent (C-D) nozzle and test section are followed by a C-D diffuser to swallow the starting shock. Here, we should have the
a) diffuser throat larger than the nozzle throat and the shock located just at the diffuser throat.
b) diffuser throat larger than the nozzle throat and the shock located downstream of the diffuser throat.
c) diffuser throat of the same size as the nozzle throat and the shock located just at the diffuser throat.
d) diffuser throat of the same size as the nozzle throat and the shock located downstream of the diffuser throat.

28) An impulsive launch of a rocket minimizes the loss of burn-out velocity due to
a) aerodynamic drag force only
b) gravitational force only
c) both aerodynamic drag and gravitational forces
d) reaction jet control force

29) Combustion in gas turbine engines is ideally represented as the following process:
a) Adiabatic
b) Isentropic
c) Isobaric
d) Isochoric

30) The pressure ratio in any one stage of a jet engine compressor is limited by
a) Entry stagnation temperature in that stage
b) entry Mach number in that stage
c) Pressure gradient induced separation in that stage
d) mass flow rate in that stage

31) Thermodynamic cycle on which the jet engine operates can be
a) open Rankine cycle only
b) either open or closed Rankine cycle
c) open Brayton cycle only
d) either open or closed Brayton cycle

32) Propulsion efficiency of a jet engine is
a) directly proportional to both the thrust power and the air mass flow rate
b) inversely proportional to both the thrust power and the air mass flow rate
c) directly proportional to the thrust power and inversely proportional to the air mass flow rate
d) inversely proportional to the thrust power and directly proportional to the air mass flow rate

33) Match the appropriate engine (in right column) with the corresponding aircraft (in left column) for most efficient performance of the engine.

a. Low speed transport aircraft	i. Ramjet
b. High subsonic civilian aircraft	ii. Turboprop
c. Supersonic fighter aircraft	iii. Turbojet
d. Hypersonic aircraft	iv. Turbofan

a) a – iv, b – iii, c – i, d – ii
b) a – ii, b – i, c – iii, d – iv
c) a – i, b – ii, c – iv, d – iii
d) a – ii, b – iv, c – iii, d – i

34) For a given chamber pressure, the thrust of a rocket engine is highest when
a) the rocket is operating at its design altitude.
b) the rocket is operating in vacuum.
c) the rocket is operating at sea-level.
d) there is a normal shock in the rocket nozzle.

35) The Poisson's ratio, v of most aircraft grade metallic alloys has values in the range:
a) $-1 \leq v \leq 0$
b) $0 \leq v \leq 0.2$
c) $0.2 \leq v \leq 0.4$
d) $0.4 \leq v \leq 0.5$

36) In a semi-monocoque construction of an aircraft wing, the skin and spar webs are the primary carriers of
a) shear stresses due to an aerodynamic moment component alone.
b) normal (bending) stresses due to aerodynamic forces.
c) shear stresses due to aerodynamic forces alone.
d) shear stresses due to aerodynamic forces and a moment component

37) Buckling of the fuselage skin can be delayed by
a) increasing internal pressure.
b) placing stiffeners farther apart.
c) reducing skin thickness.
d) placing stiffeners farther and decreasing internal pressure

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) A statically indeterminate frame structure has
a) same number of joint degrees of freedom as the number of equilibrium equations

b) number of joint degrees of freedom greater than the number of equilibrium equations
c) number of joint degrees of freedom less than the number of equilibrium equations
d) All of the above

40) A material can return to normal after it has been deformed due to its elasticity.
a) True
b) False
c) Cannot determine
d) Partially correct

41) Which of the following instruments are works on the basis of pitot-static system?
a) air speed indicator
b) altimeter
c) vertical speed indicator
d) Dturn and slip indicator

42) Poisson's ratio is defined as the ratio of
a) longitudinal stress and longitudinal strain
b) longitudinal stress and lateral stress
c) lateral stress and longitudinal stress
d) lateral stress and lateral strain

43) Hooke's law holds good up to
a) Yield point
b) limit of proportionality
c) breaking point
d) elastic limit

44) The maximum strain energy that can be stored in a body is known as
a) impact energy
b) Resilience
c) proof resilience
d) modulus of resilience

45) Which of the following statement is NOT TRUE across an oblique shock wave?
a) Static temperature increases, total temperature remains constant.
b) Static pressure increases, static temperature increases.
c) Static temperature increases, total pressure decreases.
d) Static pressure increases, total temperature decreases.

46) The aerodynamic centre of a supersonic aerofoil, with chord c, is located at
a) The leading edge
b) 0.25c
c) 0.5c
d) 0.75c

47) Concept of aerodynamic centre is
a) Point at which moment independent of angle of attack

b) Point at which net moment is zero
c) Point at which net force acts
d) Point at which net forces are zero

48) The drag divergence mach number of an airfoil.
a) is a fixed number for a given airfoil
b) is always higher than Mcr
c) is equal to Mcr at zero angle of attack
d) is the Mach number at which a shock wave first appears on the airfoil.

49) An aircraft in trimmed condition has zero pitching moment at
a) Its aerodynamic centre.
b) Its centre of gravity.
c) 25% of its mean aerodynamic chord.
d) 50% of its wing root chord

50) Which of the following statements are correct as per drag polar?
1) Take off of a subsonic aircraft is mostly affected by lift dependent drag.
2) While cruising a supersonic aircraft is mostly affected by wave drag.

a) Only 1 is correct
b) Only 2 is correct
c) Both 1 &2 are correct
d) Both 1 & 2 are wrong

Syllabus

Module 1

AERODYNAMICS: Conservation laws of mass, momentum and energy – Elementary flows and their combinations - Thin airfoil theory - Lifting line theory – Boundary layer thicknesses – Compression waves and Expansion waves - Critical Mach number, Drag Divergence Mach number, Shock Stall, Supercritical Airfoil Sections, Transonic area rule – Shock expansion theory – Aerodynamic heating.

Module 2

AIRCRAFT STRUCTURES: Plane truss analysis – Strain energy - Energy theorems - Ductile and brittle materials – Theories of failure - Thermal stresses – Creep & Fatigue - Bending of symmetric and unsymmetric beams - Thin walled beams - Bredt - Batho theory - Bending of thin plates – Loads on an aircraft - Bending moment distribution over the aircraft - Complete tension field beam, Semi-tension field beam theory.

Module 3

AIRCRAFT PROPULSION SYSTEMS: Piston engines – Gas turbine engines – Thrust augmentation – Inlets and Nozzles - Compressors and turbines – Ram jet engine – Thrust vector control - Cryogenic engines - Air augmented rockets - Pulse rocket motors - Solid and liquid propellant rockets - Hybrid rocket propulsion - Electric propulsion - Nuclear rocket propulsion - Solar sail.

Module 4

FLIGHT MECHANICS: Measurement of speed - Streamlined and bluff bodies- Forces acting on aircraft – types of Drag -Straight and level flight - Gliding and Climbing flight- Range and Endurance - Lift, drag and L/D ratio devices - Take-off and Landing performance, Turning performance - V-n diagram - Static and dynamic stability - Aerodynamic balancing - Aircraft equations of motion- Stability derivatives.

Module 5

AVIONICS SYSTEMS AND INSTRUMENTS: Avionics subsystems - Aircraft cockpit displays – Communication and Navigation systems - Pitot-Static instruments and Gyroscopic instruments – Fly by Wire and Fibre Optic control systems.

Text and Reference Books:

1. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw Hill Book Co., 1999
2. Anderson, J. D, "Modern Compressible Flow", McGraw-Hill & Co., 2002
3. Timoshenko and Gere, "Mechanics of Materials", Tata McGraw Hill, 1993.
4. Megson T M G, "Aircraft Structures for Engineering students" Elsevier , 2007
5. Hill, P.G. & Peterson, C.R. “Mechanics & Thermodynamics of Propulsion” Addison – Wesley Longman INC, 1999.
6. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 5th Edition, 1993.
7. Perkins C.D., &Hage, R.E. Airplane performance, stability and control, Wiley Toppan, 1974
8. Collinson.R.P.G. "Introduction to Avionics", Chapman and Hall, 1996.
9. Mekinley, J.L. and Bent, R.D., “Aircraft Power Plants”, McGraw-Hill, 1993.