

**ROYAL CIVIL SERVICE COMMISSION  
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2021  
EXAMINATION CATEGORY: TECHNICAL**

**PAPER III: SUBJECT SPECIALISATION PAPER FOR AERONAUTICAL/AVIONIC  
ENGINEERING**

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<b>Date</b>	: October 31, 2021
<b>Total Marks</b>	: 100
<b>Writing Time</b>	: 150 minutes (2.5 hours)
<b>Reading Time</b>	: 15 minutes (prior to writing time)

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**GENERAL INSTRUCTIONS:**

1. Write your Registration Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is to check the number of pages of Question Paper, printing errors, clarify doubts and to read the instructions. You are NOT permitted to write during this time.
3. This paper consists of **TWO SECTIONS**, namely SECTION A & SECTION B:
  - **SECTION A** has two parts: Part I - 30 Multiple Choice Questions  
Part II - 4 Short Answer Questions  
All questions under SECTION A are COMPULSORY.
  - **SECTION B** consists of two Case Studies. Choose only **ONE** case study and answer the questions of your choice.
4. All answers should be written on the Answer Booklet provided to you. Candidates are not allowed to write anything on the question paper. If required, ask for additional Answer Booklet.
5. All answers should be written with correct numbering of Section, Part and Question Number in the Answer Booklet provided to you. Note that any answer written without indicating the Section, Part and Question Number will NOT be evaluated and no marks will be awarded.
6. Begin each Section and Part on a fresh page of the Answer Booklet.
7. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
8. Use of any other paper including paper for rough work is not permitted.
9. **You must hand over the Answer Booklet to the Invigilator before leaving the examination hall.**
10. This paper has **8 printed pages**, including this instruction page.

**GOOD LUCK**

**SECTION A**

**PART I: Multiple Choice Questions [30 marks]**

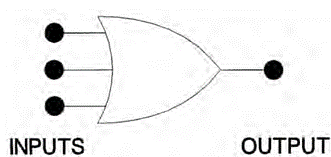
**Choose the correct answer and write down the letter of your chosen answer in the Answer Booklet against the question number e.g. 31 (d). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.**

1. International organisation which defines the protocols of investigation of air accidents is
  - a) International Court of Atomic Operation
  - b) International Civil Aviation Organisation
  - c) Intergovernmental Court of Atomic Operation
  - d) International Court of Aviation Operation
  
2. An aerofoil section is designed to produce lift resulting from a difference in the
  - a) negative air pressure below and a vacuum above the surface.
  - b) higher air pressure below the surface and lower air pressure above the surface.
  - c) vacuum below the surface and greater air pressure above the surface.
  - d) higher air pressure at the leading edge than at the trailing edge.
  
3. The prefix peco is used for
  - a)  $10^{-6}$
  - b)  $10^{-9}$
  - c)  $10^{-12}$
  - d)  $10^{-15}$
  
4. The point of minimum area in jet of flow is called
  - a) Jet point
  - b) Vena contracta
  - c) Expansion point
  - d) None of above
  
5. The device that convert the pressure into electrical output is
  - a) Bourdon tube
  - b) U-tube manometer
  - c) aneroid barometer
  - d) Pressure transducer
  
6. The failure of material under cyclic loading is called
  - a) Fatigue
  - b) Creep
  - c) Deterioration
  - d) Yielding

7. A reversed-biased PN junction has
  - a) a very narrow depletion layer.
  - b) almost zero current.
  - c) a net hole current.
  - d) a net electron current.
  
8. Which of the following examples suits the definition of an aircraft?
  - a) Aeroplane and spacecraft
  - b) Aeroplane, helicopters, airship and glider
  - c) Aeroplane, helicopter, missile and rocket
  - d) Aeroplane, helicopter, rocket and spacecraft
  
9. With regard to aircraft maintenance, what does the term MAINTENANCE means?
  - a) Carrying out periodic aircraft checks as per the maintenance manual.
  - b) Rectification of the aircraft defects when occurs.
  - c) Any one or combination of overhaul, repair, inspection, replacement, modification or defect rectification of an aircraft or component.
  - d) Doing repair, inspection and replacement of aircraft at maintenance organisation.
  
10. A specific measured distance from the datum or some point identified by the manufacturer, to a point in or on the aircraft is called a
  - a) Station number
  - b) Zone number
  - c) Reference number
  - d) Manufacturing number
  
11. The preferred method of charging a Ni-Cd battery is
  - a) Constant current
  - b) Constant voltage
  - c) Constant power
  - d) Varying power
  
12. What type of fuel is commonly used in the Morden aircraft?
  - a) Jet A
  - b) Avgas
  - c) Jet A1
  - d) Jet B
  
13. The resistance, or skin friction, due to the viscosity of the air it passes along the surface of a wing is type of
  - a) Induced drag
  - b) Form drag
  - c) Parasite drag
  - d) Interference drag

14. Which of the following Binary numbers is equivalent to decimal number 54?
- a) 111000
  - b) 110110
  - c) 110010
  - d) 101110
15. What type loads cause the most rivet failure?
- a) Shear
  - b) Bearing
  - c) Torsion
  - d) Tension
16. Overinflated aircraft tyre may cause damage to the
- a) Brake lining
  - b) Wheel hub
  - c) Wheel flange
  - d) Tyres
17. A wing which is inclined downwards from root to tip is said to have
- a) Wash out
  - b) Anhedral
  - c) taper
  - d) sweep
18. A box contains 20 balls. In how many ways can 8 balls be selected if each ball can be repeated any number of times?
- a)  ${}^{20}C_7$
  - b)  ${}^{20}C_8$
  - c)  ${}^{27}C_7$
  - d)  ${}^{27}C_8$

19. Which statement is TRUE concerning the depicted logic gate below?



- a) Any input being 1 will produce a 0 output
  - b) All input must be 0 to produce 1 output
  - c) Any inputs being 1 will produce 1 output
  - d) All input must be 1 to produce 1 output
20. Working drawing may be divided into three classes. They are
- a) title drawings, installation drawings, and assembly drawings.
  - b) detail drawings, orthographic projection drawings, pictorial drawings.
  - c) title drawings, pictorial drawings, and assembly drawing.
  - d) detail drawings, assembly drawings, and installation drawings.

21. The useful load of an aircraft consists of the
- Crew, usable fuel, oil, and fixed equipment.
  - Crew, usable fuel, passengers, and cargo.
  - Crew, passengers, usable fuel, oil, cargo, and fixed equipment.
  - Crew, passenger, baggage, and fixed equipment.
22. Which of these characteristics is desirable in turbine engine oil?
- Low flash point
  - High volatility
  - High flash point
  - Low volatility
23. An airplane is flying at standard sea level. The measurement obtained from a Pitot tube mounted on the wing tip reads  $2190 \text{ lb/ft}^2$ . What is the velocity of the airplane?
- 350 ft/s
  - 250 ft/s
  - 150 ft/s
  - 450 ft/s
24. Why are the modern aircraft wings fitted with winglets?
- To increase lift.
  - To increase wing surface area.
  - To eliminate vortices.
  - To decrease drag.
25. Icing conditions may be encountered in the atmosphere when
- pressure is high and humidity falls.
  - relative pressure is high and temperature is high.
  - relative humidity is low and temperature rises.
  - relative humidity is high and temperature is low.
26. The statement, "Pressure plus Kinetic energy is constant", refers to the
- Principle of continuity.
  - Magnus effect.
  - Bernoulli's theorem.
  - Newton's second law of motion.
27. A motion consisting of a combined rolling and yawing oscillation in an aircraft is known as
- Dutch roll
  - Anhedral
  - Sideslip
  - Dihedral
28. The stalling speed of an aeroplane is most affected by
- changes in air density.
  - variations in aeroplane flight altitude.
  - changes in pitch altitude.
  - variations in aeroplane loading.

29. The working fluid of the Gas Turbine Engine is
- a) Air
  - b) Fuel
  - c) Hydraulic fluid
  - d) Pneumatic fluid
30. The International Civil Aviation Organisation (ICAO) annex relevant to Aircraft Registration is
- a) Annex 1
  - b) Annex 7
  - c) Annex 6
  - d) Annex 8

**PART II – Short Answer Questions [20 marks]**

**This part has 4 Short Answer Questions. Answer ALL the questions. Each question carries 5 marks. Mark for each sub-question is indicated in the brackets.**

**Question 1**

- a) What are the four components of Safety Management System? (1 mark)
- b) What is meant by the centre of pressure of an aerofoil? (1 mark)
- c) What is Aspect Ratio and what is its significance? (3 marks)

**Question 2**

- a) Explain stall and what are the factors affecting stall? (2 marks)
- b) What are the six degrees of freedom of an aeroplane? (1 mark)
- c) What is the meaning of (a) subsonic, (b) supersonic speeds? (2 marks)

**Question 3**

- a) What is meant by Airworthiness of aircraft? What makes an aircraft airworthy? Who is responsible for aircraft airworthiness? (3 marks)
- b) Why is the tip speed an important factor in propeller design? (2 marks)

**Question 4**

- a) What are the four forces acting on an aircraft in straight, level and unaccelerated flight? Briefly explain each of them. (3 marks)
- b) Why are turbine combustion chamber supplied with air very much in excess of what is needed to burn the fuel? (1 mark)
- c) At what part of a wing does a shock wave first form? (1 mark)

**SECTION B: Case Study [50 marks]**

**Choose either CASE I or CASE II from this section. Each case study carries 50 marks. Mark for each sub-question is indicated in the brackets.**

**CASE I**

Complacency and non-adherence to the binding regulations could have a devastating impact in any organization, if not treated from the very outset. As such, in the aviation industry, there could be no room for any complacency when the safety of the passengers are at stake. It is critical to use sound knowledge and judgment by the Civil Aviation Authority safety officer to prevent such non-compliance so as to avoid any mishap.

In relation to the above abstract, an incident occurred with the ABC airline.

On 13 March 2015, an Airworthiness Directives (AD) was issued for the Airbus A320 fleets mandated to carry out special inspection on the flight controls. The due date for AD was on or before 30 December 2015.

ABC airline has five A320s in their fleet. The airline did not carry out the AD as mandated and continued to operate beyond the deadline.

With regard to the above, answer the following:

1. What is the Airworthiness Directive and who issues such directives? Why is it crucial to comply? (10 marks)
2. What would be the consequences associated with such non-compliance? How can such non-complaints be mitigated in future? (10 marks)
3. List down the probable cause of the non-compliance. (10 marks)
4. What are the primary and secondary flight controls? Briefly describe function of each flight controls. (10 marks)
5. Explain the following error model? (5 + 5 marks)
  - a) PEAR model
  - b) The James REASON 'Swiss cheese' model

**CASE II**

The Covid-19 pandemic has tremendously impacted the global economy, especially the aviation and tourism industries. As most of the country's economy relies upon tourism, the only way possible to open tourism is by resuming commercial air transportation. However, to do so, the aircraft owner has to make their aircraft airworthy as most of the airline's fleet were in parking and storage mode due to Covid-19 pandemic.

With the lack of capable aircraft maintenance organization in the country, the airline is facing challenges to accomplish the aircraft maintenance checks on time. The option of outsourcing the maintenance checks to foreign aircraft maintenance organizations seems even daunting due to the financial cost and Covid-19 restrictions.

Write a proposal to tackle and mitigate the above problems. Your proposal should include the following besides others:

1. What is aircraft maintenance? Define types of aircraft maintenance. (5 marks)
2. What is an aircraft maintenance organisation? What are the requirements for an aircraft maintenance organisation? (5 marks)
3. Recommendations on how to resume normal commercial operations amidst the Covid-19 pandemic in the interest of restoring country's tourism and economy. (10 marks)
4. How shall the airline operator ensure the continued airworthiness of the grounded fleet due to Covid-19 pandemic? (5 marks)
5. Consequences if the airlines resume the commercial operation immediately in the interest of restoring the company's business. (10 marks)
6. How could the company's aircraft maintenance facilities be improved to avoid such circumstances in the future? (10 marks)
7. How could the civil aviation authority/government facilitate airline operators to tackle such issues? (5 marks)

**TASHI DELEK**