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Question Paper Code: AAEB24



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech VII SEMESTER END EXAMINATIONS (REGULAR/SUPPLEMENTARY) - DECEMBER 2022

Regulation: R18

FLIGHT VEHICLE DESIGN

Time: 3 Hours

(AERONAUTICAL ENGINEERING)

Max Marks: 70

Answer FIVE Questions choosing ONE question from each module

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

MODULE – I

- (a) What is the initial phase of an aircraft design? Describe in detail about the design philosophy of an aircraft and explain with the help of diagram. [BL: Understand| CO: 1|Marks: 7]

(b) Is the design of an airplane a complex engineering task? It generally involves the various factors. What are they? Explain about them in brief. [BL: Apply| CO: 1|Marks: 7]
- (a) Explain in detail about preliminary design process of aircraft design, with help of neat diagram. [BL: Understand| CO: 1|Marks: 7]

(b) An aircraft with crew and payload of 180kg is flying with a fuel weight fraction of 0.353 and empty weight fraction as 0.481 then, what will be the gross weight of aircraft? [BL: Apply| CO: 1|Marks: 7]

MODULE – II

- (a) Describe the process of weight estimation – outline of approach in flight vehicle design. [BL: Understand| CO: 2|Marks: 7]

(b) An aircraft has cruise range of 1500NM and SFC $C = 0.5$ 1/hr. Cruise velocity of jet aircraft is 570ft/s with L/D as 13.2. Aircraft is supposed to do loiter of 2 hrs. Then what should be the gross weight of aircraft? Given, empty weight fraction of 0.55, crew and payload of 6500kg with 0.98 as mission segment fuel fraction for climb, take-off and landing. [BL: Apply| CO: 2|Marks: 7]
- (a) Mention the different types of tail configurations and wing configurations are available? Explain their effects with neat sketches. [BL: Understand| CO: 2|Marks: 7]

(b) An aircraft has crew and payload of 180kg. It has empty weight fraction of 0.48 and fuel weight is 0.7 times empty weight. What will be the gross weight of an aircraft? [BL: Apply| CO: 2|Marks: 7]

MODULE – III

- (a) Explain the landing gear arrangements for multi-wheel main landing gear with a neat sketch. [BL: Understand| CO: 3|Marks: 7]

- (b) A jet transport aircraft is flying with crew load of 175kg, payload of 1400kg and fuel weight of 500kg. Find out fuel to empty weight fraction, if design take-off gross weight of the aircraft is 5600lb. [BL: Apply| CO: 3|Marks: 7]
6. (a) Describe inlet geometry design with pitot inlet layout and inlet location for buried engines. [BL: Understand| CO: 4|Marks: 7]
- (b) Cessna 172R has total gross weight of the 1110.98kg with fuel capacity of 210 kg and weight of crew and passenger is 125kg. Find out empty weight fraction. [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

7. (a) What is the importance of sizing? Explain in detail about refined sizing method with help of neat sketch. [BL: Understand| CO: 5|Marks: 7]
- (b) A jet transport aircraft has fuel storage of 1200kg. It has completed taxi phase and preparing for take-off. At the end of the taxing, it has fuel fraction of 0.98. Determine how much fuel is available after taxing? Given take-off gross weight is 9000kg. [BL: Apply| CO: 5|Marks: 7]
8. (a) Differentiate the static and dynamic stability of an aircraft with suitable examples and how the stability is important in design of an aircraft. [BL: Understand| CO: 5|Marks: 7]
- (b) A prop-driven aircraft having fuel weight of 650kg. Now, aircraft is taxing on runway, after which it has fuel fraction of 0.975. Determine fuel used during taxing of aircraft, if $W_0 = 5000\text{kg}$. [BL: Apply| CO: 5|Marks: 7]

MODULE – V

9. (a) Describe detail sizing methods with the equations which are the basis of the highly-detailed sizing programs used by the major airframe companies. [BL: Understand| CO: 6|Marks: 7]
- (b) If an aircraft has lift curve slope of 4.76 per rad and moment coefficient curve slope of -0.116 per rad then, find the location of neutral point. Consider $X_{cg}=0.3$. [BL: Apply| CO: 6|Marks: 7]
10. (a) Explain how many engineering hours during the RDT and E phase were actually spent in support of production. [BL: Understand| CO: 6|Marks: 7]
- (b) An aircraft with wing aft tail configuration has tail efficiency of 0.95 and tail volume ratio of horizontal tail is 0.7. Determine pitching moment coefficient slope for the tail. Given lift curve slope of tail is 4.2 per rad. Consider downwash derivative as 0.6. Find tail efficiency if, dynamic pressure at tail and wing is 25Pa and 28Pa respectively. [BL: Apply| CO: 6|Marks: 7]

