MALL A REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF AERONAUTICAL ENGINEERING

III YEAR I SEMESTER

QUESTION BANK

S. No.	NAME OF THE SUBJECT
1	INTRODUCTION TO SPACE TECHNOLOGY
2	AIRCRAFT MATERIALS AND COMPOSITES
3	AEROSPACE VEHICLES STRUCTURES – II
4	HIGH SPEED AERODYNAMICS – II
5	AIRCRAFT STABILITY AND CONTROL
6	MECHANISMS AND MECHANICAL DESIGN

MALLA REDDY COLLEGE OF ENGINEERING ANDTECHNOLOGY
(UGC AUTONOMOUS)
III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING
INTRODUCTION TO SPACE TECHNPLOGY (R15)
MODEL PAPER – I
MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1. Classify the various types of rockets based on type of propellant used.
2. Explain about the various flight dispersions possible during pre and post launch
3. Explain in advantage of reentry vehicle.
4. Explain about dip reentry and mention the equation of velocity for the same
5. Explain in brief the various orbital elements.
6. Explain in brief the Hohmann transfer
7. Explain few points Attitude control required for non spinning aircraft.
8. Explain about the Yo- Yo Mechanism
9. Explain about team interfaces in brief.
10. Explain about Core operations in missions

PART B **Max Marks: 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

1. Explain with neat sketches the working principle of chemical rocket – Solid and liquid propellants.

(or)

2. Derive the rocket equation with required sketches .

3. Explain and derive the expressions required for skip reentry.

(or)

4. Explain and derive the expressions required for Aero-ballistic reentry.

5. a. Explain the classical orbital elements with equations.

(or)

6. Explain the Bielliptical Transfer.

7. A) Derive equation for the YO-YO mechanism
   B) Explain about the Gravity-gradient torques on closed earth satellite?

(or)

8. Explain attitude determination required during planning a mission.

9. A) Explain in detail about the Mission phases and core operations?
   B) Explain in your view about the standard operation practices.

(or)

10. Explain high level space mission operations with required sketches.

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III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING
INTRODUCTION TO SPACE TECHNPLOGY (R15)
MODEL PAPER – II
MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1. Explain about injector and its types.
2. Write the rocket equation and explain all the terms
3. Differentiate RLV and ELV.
4. Explain the main points required for steep ballistic reentry
5. Mention eccentricity values of all the orbits.
6. Explain the points considered for propulsion in maneuvers
7. Define the orbital elements?
8. Write about Right ascension?
9. Explain in brief mission architecture
10. Explain the mission ground support duties

PART B **Max Marks: 50**

i Answer only one question among the two questions in choice.
ii Each question answer (irrespective of the bits) carries 10M.

1. Write a short note on the following aspects related to combustion of solid propellants:
   (a) Progressive, Erosive and neutral burning
   (b) Types of propellants
   (c) Different types of grains arrangement.

(or)

2. A rocket projectile has the following characteristics:

Initial mass	200 kg
Mass after rocket operation	130 kg
Payload, non propulsive structure, etc.	110 kg
Rocket operating duration	3.0 sec
Average specific impulse of propellant	240 sec

   Determine the vehicle's mass ratio, propellant mass fraction, propellant flow rate, thrust, thrust-to-weight ratio, acceleration of vehicle, effective exhaust velocity, total impulse, and the impulse-to-we .

3. (a) Explain the effects of deceleration on the trajectory of a re-entry space vehicle. Indicate the deceleration profiles for various re-entry velocities and re-entry flight path angles, in a graphical form.
   (b) Write a short note on `Ablation' as a thermal protection system.

(or)

4. Explain and derive the expressions required for Dip reentry.

5. The earth's mean heliocentric velocity is 29.78 km/s. Assume that meteors travel in parabolic Heliocentric orbits. Show that the speed of approach of meteors towards earth lies between 12.3 and 71.9 km/s.

(or)

6. 16) Determine the orbital period of a spacecraft whose perigee and apogee are at an altitude of 122 km And 622 km, respectively
   Show that the period of an orbit close to the surface of a homogeneous spherical planet is a function of planetary density only

7. A satellite transfers from a low circular orbit or radius 7000 km to a circular orbit with a period of 12 hours.
   (a) What is the radius of final orbit?
   (b) If a Hohmann transfer is used, calculate the eccentricity of the transfer ellipse and total velocity increment.
   (c) Is it possible to achieve fuel economy using belliptic 3 impulse transfer instead

(or)

8. Explain the terms
   a. Specific Mechanical Energy
   b. Specific Angular Momentum.
   c. Velocity
   d. True anamoly

9. Explain in detail about the Radiation effects and Launch environment?
   B) What do you know about the Charged particle motion
   b) VAN ALLEN belts?

(or)

10. Explain in detail about the factors do we consider for selecting a commercial launch vehicle?

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III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING
INTRODUCTION TO SPACE TECHNPLOGY (R15)
MODEL PAPER – III
MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1) Discuss about the Different types of solid rocket propellants?
2) Explain about the Bielliptical transfer?

3) Explain about the
   i) Ballistic entry
   ii) Atmospheric entry

4) Explain about the Skip entry and glide entry?

5) Give expression for velocity, period of satellite

6) Explain about inplane orbit changes

7) Write short notes on the Hohmann transfer?

8) Explain about the Bielliptical transfer?

9) What do you know about Attitude determination?

10) Discuss about the Ground system architecture?

PART B **Max Marks: 50**

i Answer only one question among the two questions in choice.
ii Each question answer (irrespective of the bits) carries 10M.

1) Derive the Rocket equation for the Multi stage Rocket with necessary diagrams?

(OR)

2) A) Explain in detail about the liquid and solid propellants
   B) Explore about the Space Mission types

3) Derive the general equation of motion of for atmospheric entry?

(OR)

4) Discuss about the space vehicle trajectories with some basic aspects?

5) Derive the general equation of motion for two body motion?

(OR)

6) Prove that the earth takes two days more than half a year to travel over half of its orbit separated by Minor axis away from the sun. It is given that period of the earth is 365 days and the eccentricity of The orbit is 1/60.

7) Derive the Equation of torque for the Axi-Symmetric body.

(OR)

8) Discuss about Gradient satellite –Dual spin Spacecraft with the mathematical equations?

9) Discuss in detail about the following with appropriate sketches? A) Team responsibilities B) Mission Delivery.

(OR)

10) Explain in detail about Spherical Geometry, Various Axes Systems with neat sketches?

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III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING
INTRODUCTION TO SPACE TECHNPLOGY (R15)
MODEL PAPER – IV
MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1) Discuss about the Grain designs with figures?

2) Write about the Gravity turn Trajectories?

3) Explain about the Lifting Entry?

4) Write about the Aerodynamic heating?

5) Explain about the Gravity Loss with respect altitude?

6) What is meant by Orbital Mechanics?

7) Write about the requirement of Space Mission communication?

8) What do you mean by Mach number independence?

9) What are standard operation practices?

10) What is “SPIN- STABILIZATION?

PART B **Max Marks: 50**

i Answer only one question among the two questions in choice.
ii Each question answer (irrespective of the bits) carries 10M.

1) Derive and explain about the Two- Dimensional trajectories of the Rockets?

(OR)

2) Explain about the following A) Impact point calculation B) Flight dispersions.

3) Derive the Orbit equation with neat sketches?

(OR)

4) Discuss in detail about the Aero-braking and Lifting body Reentry.

5) The semi major axis of a satellite when injected into the orbit has a semi major axis of 1.0478 earth radii and a period of 90.54 min. Calculate the mass of the earth in the units of the sun’s mass.

(OR)

6) A satellite transfers from a low circular orbit or radius 7000 km to a circular orbit with a period of 12 hours. (a) What is the radius of final orbit? (b) If a Hohmann transfer is used, calculate the eccentricity of the transfer ellipse and total velocity increment.
7) Explain in detail about the Semi-rigid spacecraft?

(OR)

8) Discuss about the Gravity gradient satellite with neat sketches?

9) Distinguish the difference between the Spin stabilization and dual spin stabilization attitude control mechanisms for the space craft?

(OR)

10) Explain in detail about the satellite control networks and their working procedure?

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III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING
INTRODUCTION TO SPACE TECHNPLOGY (R15)
MODEL PAPER – V
MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1) What do you know about the interplanetary probes?
2) What is Sounding Rocket?
3) What is meant by Exponential atmosphere?
4) Explain about the entry trajectory on a velocity-altitude map?
5) Write about the conic section geometry?
6) Explain about the long-range function?
7) Define the orbital elements?
8) Write about Ballistic parameter?
9) What is meant by solar radiation torque?
10) Write the advantages of glide entry?

PART B **Max Marks: 50**

i Answer only one question among the two questions in choice.
ii Each question answer (irrespective of the bits) carries 10M.

1) Explain in detail about the Radiation effects and Launch environment? B) What do you know about the a) Charged particle motion b) VAN ALLEN belts?

(OR)

2) Explain in detail about the factors do we consider for selecting a commercial launch vehicle?
3) Derive the equation for the high temperature flow field around a blunt body

(OR)

4) Show that for $\mu = 0.5$, the curves are symmetric about y-axis also and that the points L1,L2 are reached Simultaneously when constant C is continuously decreased starting with a very large initial value. Compute the position of the five Lagrange points in the case $\mu = 0.5$.
5) The earth's mean heliocentric velocity is 29.78 km/s. Assume that meteors travel in parabolic Heliocentric orbits. Show that the speed of approach of meteors towards earth lies between 12.3 and 71.9 km/s.

(OR)

6) Determine the orbital period of a spacecraft whose perigee and apogee are at an altitude of 122 km And 622 km, respectively.

7) Show that the period of an orbit close to the surface of a homogeneous spherical planet is a function of planetary density only.

(OR)

8) A satellite transfers from a low circular orbit or radius 7000 km to a circular orbit with a period of 12 hours.

(a) What is the radius of final orbit?

(b) If a Hohmann transfer is used, calculate the eccentricity of the transfer ellipse and total velocity increment.

(c) Is it possible to achieve fuel economy using belliptic 3 impulse transfer instead.

R15 III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING

AEROSPACE MATERIALS AND COMPOSITES (CORE ELECTIVE – I)

MODEL PAPER – I
MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1. Define the terms: proof stress, proportional limit of a material. (2 M)
2. What is Bauschinger effect? State the basic mechanism. (3 M)
3. Differentiate wrought and cast aluminum alloys. (2 M)
4. What is use of strain hardened alloys in aircraft construction? (3 M)
5. Differentiate among fiber composites and particulate composites. (2M)
6. Give two examples of each: Nature made composites, polymer composites and ceramic composites. (2 M)
7. Define sandwich – structured composite. (2 M)
8. What are the factors on which the strength of a composite depends upon? (3 M)
9. What are the different bending tests? (2 M)
10. What is the purpose of magnaflux inspection method? Brief. (3 M)

PART B **Max Marks: 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

11. Define impact energy. Explain the significance of notch testing in materials. (10 M)

OR

12. What is work/strain hardening? How does it affect the properties of a material? Explain. (10M)

13. What are the advantages and disadvantages of all α Ti alloy, combined α-β Ti alloy and non-heat treatable β Ti alloy? Explain briefly. (10 M)

OR

14. How are the internal stresses relieved in Monel? What are the chemical, physical and working properties of Monel? (10 M)

15. What are the factors effecting the properties of a composite? Explain in detail. (10 M)

OR

16. Explain in detail, the classification of composites. Brief each of them along with their advantages, disadvantages and applications. (10 M)

17. State and explain the manufacturing methods of sandwich structures. (10 M)

OR

18. How does the temperature variation affect the materials used for airplanes flying at different mach numbers. Explain. (10 M)

19. How did the use of composite materials grow in recent years? Elaborate in detail. (10 M)

OR

20. Explain in detail the non – destructive flaw detection techniques used in aerospace industry. (10 M)

R15 III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING

AEROSPACE MATERIALS AND COMPOSITES (CORE ELECTIVE – I)

MODEL PAPER – II

MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1. Define the terms creep and fatigue. (2 M)
2. State applications of silica based ceramics in aerospace (3 M)
3. What is meant by α stabilizer and β stabilizer in alloying Titanium? (3 M)
4. State the application of CP Ti (Commercially pur Ti) in aerospace industry. (2 M)
5. Differentiate among thermosetting and thermoplastic polymers. (2 M)
6. What is the purpose of filler in polymer composites? What are the commonly used fillers? (3 M)
7. State the factors effecting selection of materials for airplane parts. (3 M)
8. State the application of sandwich structures in aerospace. (2 M)
9. What are the applications of Titanium sponge (Ti6Al4V) alloy? (2 M)
10. What are the properties dominant in choosing a material chosen for tail and wing? (3 M)

PART B **Max Marks: 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

11. Define hardness. Explain in brief the procedures in use to test the hardness of a material. **(10 M)**

OR

12. Explain Bauschinger effect in materials using a neat sketch. **(10 M)**

13. What is the effect of various alloying elements on steel? Explain in detail. **(10 M)**

OR

14. Explain in brief the carburizing techniques used for surface hardening of steel. (10 M)

15. Define controlled anisotrophy. What are the features of fiber – reinforced polymer matrix composites leading to their broad application in aerospace industry? Explain.

OR

16. State the properties of carbon and graphite fibers. (10 M)

17. Using neat sketch, explain different failure modes of a sandwich construction. (10 M)

OR

18. What are the significant physical and chemical properties of a material used in construction of an airplane? Explain. (10 M)

19. Focus on the latest developments in materials in India. (10 M)

OR

20. What are the loads taken by the tail part of an conventional airplane? What are the properties preferred by the material used for the same? Explain. (10 M)

R15 III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING

AEROSPACE MATERIALS AND COMPOSITES
(CORE ELECTIVE – I)

MODEL PAPER – III

MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1. Differentiate between an alloy and composite. (2M)
2. Define: Brittleness, Elasticiticity and Malleability. (3 M)
3. What is a refractory material? What are the oxides used to manufacture refractory materials? (3 M)
4. State the methods used for heat treatment of steel. (2 M)
5. State the advantages of metal matrix composites over polymer matrix composites. (3 M)
6. State the applications of carbon reinforced polymer composite material. (2 M)
7. State the significance of strength/weight ratio. (3 M)
8. What is a shape memory alloy? Which metal is predominant in shape memory alloy? (2 M)
9. What are the disadvantages of composite materials? (2 M)
10. Which material is chosen for the turbo plant of an aircraft and why? (3 M)

PART B **Max Marks: 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

11. Define yield strength and yield point. Explain in brief the procedures used to determine yield strength of a material. **(10 M)**

OR

12. a. Define fatigue. Explain the working of rotating cantilever fatigue testing apparatus. **(5M)**

b. Explain principle of Radiography used for detecting flaws in airplane structures. **(5M)**

13. State the properties and applications of Martensitic or maraging steels.

OR

14. Write a short notes on

a. Galvanizing

b. Sherardizing
c. Parkerizing
d. Granodizing (10 M)

15. Explain the properties of: Ceramic fibers, Silicon carbide fibers, HPPE Fibers. (10 M)

OR

16. Write a brief note on properties of polymers used as a matrix material for composites. (10 M)

17. Define shape memory alloy. How does the shape memory alloy define the future aerospace industry? Discuss in detail. (10 M)

OR

18. Explain the requirements of designing composite sandwich structure. (10 M)

19. Define super alloy. Explain the metallurgical process of Ni based super alloy. (10 M)

OR

20. Focus on the applications of super alloys in aerospace industry. (10 M)

R15 III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING

AEROSPACE MATERIALS AND COMPOSITES
(CORE ELECTIVE – I)

MODEL PAPER – IV

MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1. State any three flaw detection techniques used in testing the materials. (2M)
2. What is a plasticizer? How does it affect the property of a plasticizer? (3 M)
3. Give the percentage of metals used in the following alloys: Inconel, monel, nimonic super alloys. (3 M)
4. What is the approximate composition of metals in corrosion resistant steels? (2 M)
5. What is a cermet? What is the application of Tungsten-carbide cermets? (2 M)
6. Distinguish continuous and discontinuous fiber reinforced composites. (3 M)
7. What are the characteristics of sandwich structures? (2 M)
8. What are the advantages of honeycomb sandwich structure? (3 M)
9. What is a super alloy? (2 M)
10. What are the characteristics of Si-Al-Bronze alloys? (3 M)

PART B **Max Marks: 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

11. a. Write a brief notes on composite materials and their application in aerospace engineering. **(5 M)**
b. Define Tensile strength and elastic limit. How do you determine the elastic limit of a material. **(4 M)**
OR
12. a. Define fracture. State and brief the mechanisms adopted for improving fracture toughness of a material. **(10 M)**

13. a. Explain in brief the heat treatment process of 18-8 austenitic steels. (5 M)
b. Write brief notes on applications of refractory materials and silica based ceramics in aerospace industry.
OR

14. Explain briefly the following heat treatment process of aluminum alloys
    a. Solution heat treatment
    b. Precipitation heat treatment **(10 M)**

15. Explain briefly the fabrication of thermosetting resin matrix composites. (10 M)

    OR

16. Explain briefly the fabrication of metal matrix composites. (10 M)

17. Explain in detail the factors effecting the selection of materials for aircraft engines. (10 M)

    OR

18. What are the properties to be considered for a material to be used for a) Nose cone (different Mach regimes) b) internal wing structure c) Skin of the aircraft. (10 M)

19. Define Functionally graded materials (FGM). State its applications. (10 M)

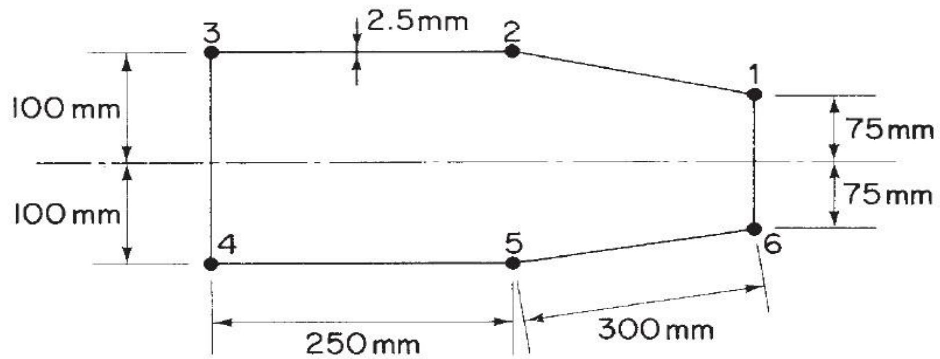
    OR

20. Explain the various mechanical tests performed to determine the physical properties of a material. (10 M)

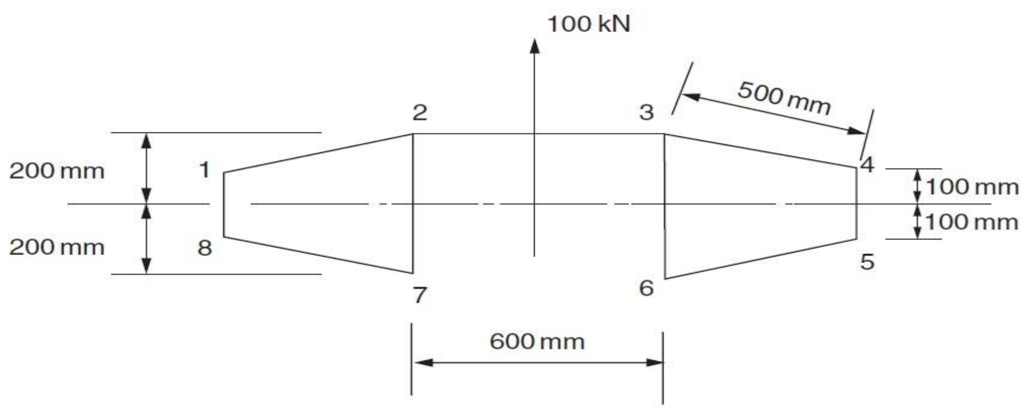
AEROSPACE VEHICLE STRUCTURES -II
Model Question Paper – I

PART A
ANSWER ALL QUESTIONS

1. Write about resolution of bending moments with neat sketches.
2. Explain the energy method for bending of thin plates?
3. What are the factors that determine the angle of diagonal tension? If the flanges and stiffness are rigid what will be the angle of diagonal tension?
4. Write short notes on the following: i. Symmetrical bending ii. Unsymmetrical bending.
5. Explain the following terms. i. Shear center ii. Shear flow iii. Centre of twist.
6. Find the section properties of the following idealized panel.



7. Find the sectional properties of given section

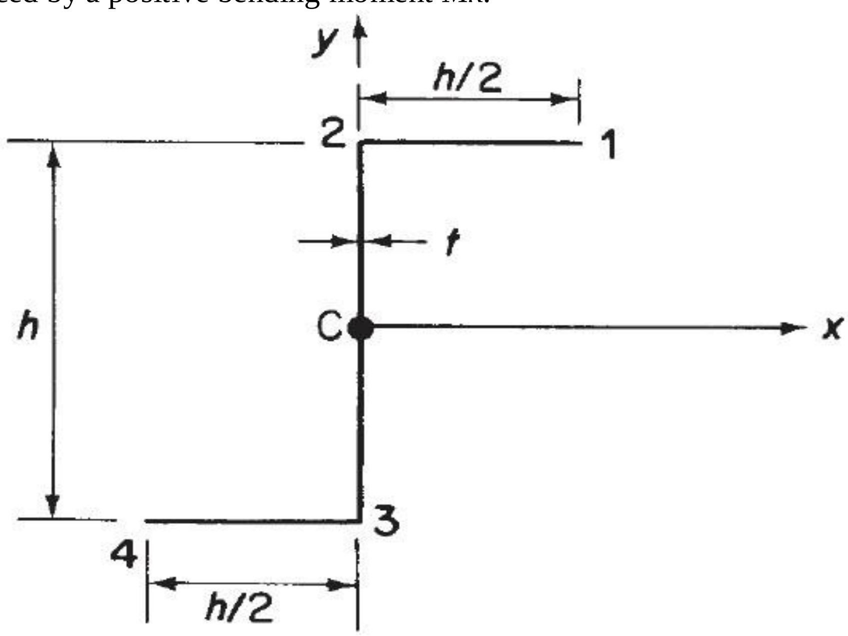


8. Write a short note on loading discontinuities in beams?
9. Write short onte on fuselage frames and wing ribs?
10. Explain about determinate and indeterminate structure of wing and fuselages?

1. Determine the deflected form of the thin rectangular plate a × b is simply supported along its edges and carrying a uniformly distributed load of intensity q0. In addition to that it supports an in-plane tensile force Nx per unit length. Here µa¶ is length and Ƀ¶ is width of the plate.

(OR)

2. A simply supported beam has a span of 2.4m and carries a central concentrated load of 10 kN. The flanges of the beam each have a cross-sectional area of300mm^2 while that of the vertical web stiffeners is 280mm^2. If the depth of the beam, measured between the centroids of area of the flanges, is 350mm and the stiffeners are symmetrically arranged about the web and spaced at 300mm intervals, determine the maximum axial load in a flange and the compressive load in a stiffener. It may be assumed that the beam web, of thickness 1.5 mm, is capable of resisting diagonal tension only.
3. Determine the direct stress distribution in the thin-walled Z-section shown in Fig. produced by a positive bending moment *Mx*.



(OR)

4. A thin-walled closed section beam has the singly symmetrical cross-section shown in Fig. Each wall of the section is flat and has the same thickness *t* and shear modulus *G*. Calculate the distance of the shear centre from point 4
5. Idealize the box section shown in Fig. into an arrangement of direct stress carrying booms positioned at the four corners and panels which are assumed to carry only shear

(OR)

10. The central cell of a wing has the idealized section shown in Fig. If the lift and drag loads on the wing produce bending moments of í 120 000Nm and í 30 000Nm, respectively at the section shown, calculate the direct stresses in the booms. Neglect axial constraint effects and assume that the lift and drag vectors are in vertical and horizontal planes.
    Boom areas: $B1 = B4 = B5 = B8 = 1000mm^2$ $B2 = B3 = B6 = B7 = 600mm^2$

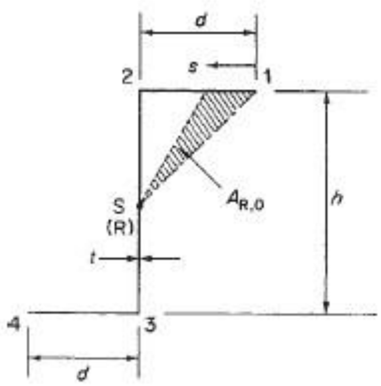
(OR)

6. The wing section shown in Figure has been idealized such that the booms carry all the direct stresses. If the wing section is subjected to a bending moment of 300 kN m applied in a vertical plane, calculate the direct stresses in the booms. Boom areas: $B_1 = B_6 = 2580\ \text{mm}^2$ $B_2 = B_5 = 3880\ \text{mm}^2$ $B_3 = B_4 = 3230\ \text{mm}^2$

(OR)

7. The unsymmetrical panel shown in Fig. comprises three direct stress carrying booms and two shear stress carrying panels. If the panel supports a load *P* at its free end and is pinned to supports at the ends of its outer booms determine the distribution of direct load in the central boom. Determine also the load in the central boom when *A*=*B*=*C* and shear lag effects are absent.

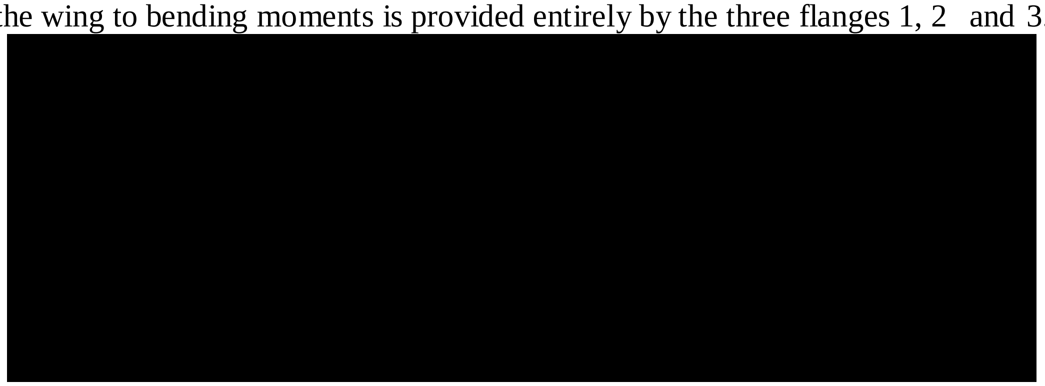
8. An open section beam of length L has the section shown in Figure. The beam is firmly built-in at one end and carries a pure torque T. Derive expressions for the direct stress and shear flow distributions produced by the axial constraint (the 1 = and q = systems) and the rate of twist of the beam



9. Calculate the shear flows in the web panels and direct load in the flanges and stiffeners of the beam shown in Figure if the web panels resist shear stresses only.

(OR)

10. Calculate the shear flows in the web panels and the axial loads in the flanges of the wing rib shown in Figure. Assume that the web of the rib is effective only in shear while the resistance of the wing to bending moments is provided entirely by the three flanges 1, 2 and 3.



(OR)

4. A single cell, thin-walled beam with the double trapezoidal cross-section shown in Fig is subjected to a constant torque T =90 500Nmand is constrained to twist about an axis through the point R. Assuming that the shear stresses are distributed according to the Bredt±Batho theory of torsion, calculate the distribution of warping around the cross-section. Illustrate your answer clearly by means of a sketch and insert the principal values of the warping displacements. The shear modulus G=27 500N/mm2 and is constant throughout.

5. Part of a wing section is in the form of the two-cell box shown in Figure in which the vertical spars are connected to the wing skin through angle sections, all having a cross-sectional area of 300 mm^2. Idealize the section into an arrangement of direct stress-carrying booms and shear-stress-only-carrying panels suitable for resisting bending moments in a vertical plane. Position the booms at the spar/skin junctions.

AEROSPACE VEHICLE STRUCTURES -II
Model Question Paper – IV

PART A
ANSWER ALL QUESTIONS

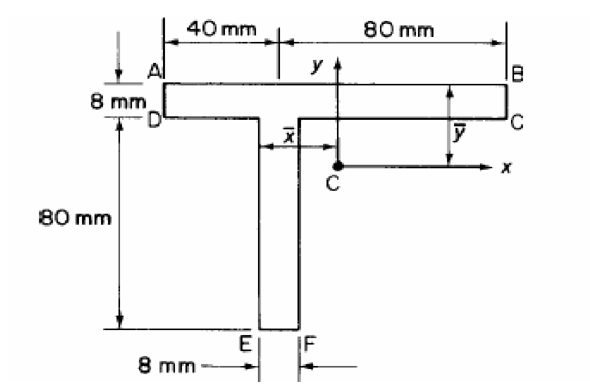
1. Explain Instability of Stiffened panels.
2. A plate 10mmthick is subjected to bending moments Mx equal to 10 Nm/mm and My equal to 5 Nm/mm. Calculate the maximum direct stresses in the plate.
3. Explain about Bredt±Batho theory and formula.
4. Explain the condition for Zero warping at a section, and derive the warping of cross section.
5. What is the alternative method to find the shear flow distribution of idealized section.
6. Explain unitload method to find the deflection of beams.
7. Write the expressions for the bending and shear displacements of unsymmetrical thin-walled Beam using unitload method.
8. Write about general aspects of structural constraints.
9. What are the different methods of analysis for open section beams of wing structure?
10. Explain the effect of taper on shearflow distribution of wings.

PART A
ANSWER ALL QUESTIONS

1. Derive the equation M_{xy} = D (1-#) $\sim^{2}w/\sim x\sim y$ for a thin plate subjected to bending and twisting.

(OR)

2. What are complete and incomplete diagonal tensions in Tension field beams? Also derive the equation to find out the uniform direct compressive stresses induced by the diagonal tension in the flanges a n d stiffeners.
3. A beam having the cross section shown in Figure is subjected to a bending moment of 1500 Nm in a vertical plane. Calculate the maximum direct stress due to bending stating the point at which it acts.



(OR)

4. Derive the equations to find out the primary and secondary warping of an open cross section subjected to Torsion.
5. The thin-walled single cell beam shown in Figure has been idealized into a combination

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III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING
HIGH SPEED AERODYNAMICS - II (R15)
MODEL PAPER – I
MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1. Define compressible and incompressible flows. (2 M)
2. Using a neat sketch show the shock pattern in supersonic flow regime and state the changes in the flow after a shock wave. (3 M)
3. Define one – dimensional flow and quasi one – dimensional flows. Give suitable examples for each. (3 M)
4. For a calorically perfect gas prove that the square of mach number is proportional to ratio of kinetic and internal energy. (2 M)
5. Using necessary assumptions prove that the tangential component of flow velocity is preserved across an oblique shock wave. (3M)
6. Using neat sketch, define Mach reflection. (2 M)
7. Define the terms choking, over expanded, under expanded nozzles. (2 M)
8. Give the relation between incompressible pressure/force coefficient and compressible pressure/force coefficients in a linearised subsonic flow. (3 M)
9. Formulate finite difference method. (2 M)
10. Define truncation error and round – off error. (3 M)

PART B **Max Marks: 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

11. A pressure vessel has a volume of 10 m^3 is used to store a high pressure air for operating a supersonic wind tunnel. If the air pressure and temperature inside the vessel are 20 atm and 300 K respectively, calculate
    a. Mass of the air stored inside the vessel
    b. Total energy of the gas stored inside the vessel
    c. If the gas in the vessel is heated, the temperature rises to 600 K calculate the change in entropy of the air inside the vessel.

OR

12. a. State second law of thermodynamics and derive the relations for calculating the change in entropy.

b. Derive the isentropic flow relations.
In either, explain the nomenclature used clearly.

13. Starting from the steady flow one dimensional energy equation derive the various alternative forms of energy equations. Explain all the symbols used clearly.

OR

14. For the flow across a normal shock
    a. Prove that $a^{*2} = u_1 u_2$ (Prandtl's relation)
    b. The Mach number behind a normal shock is always subsonic.
    c. The total temperature across a normal shock wave is constant

15. Making necessary assumptions/using required conditions derive the relation between flow deflection angle, shock angle and upstream Mach number (θ-β-M)

OR

16. a. Derive the governing equation for Prandtl – Meyer expansion flow.
    b. Consider the flow past an expansion corner of angle 30^o. The upstream Mach number, pressure and temperature are given by 2, 3 atm and 400 K respectively. Calculate the downstream Mach number, pressure, temperature, total temperature and total pressure.

17. Consider a flat plate at with chord length *c* at an angle of attack α to a supersonic free stream mach number M_∞. Let *L* and *D* be lift and drag per unit span S is plan-form area of the plate per unit span, $S = c(1)$. Using linearised theory, derive the following expressions for lift and drag coefficients.

$$C_L = \frac{4\alpha}{\sqrt{M_\infty^2 - 1}}\ ;\ C_D = \frac{4\alpha^2}{\sqrt{M_\infty^2 - 1}}$$

OR

18. Consider a rocket engine burning Hydrogen and oxygen. The combustion chamber pressure and temperature are 25 atm and 3571 K, respectively. The molecular weight of the chemically reacting gas in the combustion chamber is 16. The pressure at the exit of the convergent – divergent rocket nozzle is 1.174×10^2 atm. The throat area is 0.4 m^2. Assuming a calorically perfect gas, calculate a) the exit Mach number , b) the exit velocity , c) the mass flow through the nozzle , and d) the area at the exit

19. a. Explain about similarities of flow to be satisfied for Model testing.
    b. Illustrate the flow over a delta wing in supersonic flow.

OR

20. Write a short note on Hotwire anemometer.

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HIGH SPEED AERODYNAMICS - II (R15)
MODEL PAPER – II
MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1. State first and second law of Thermodynamics. Define entropy, internal energy and enthalpy. (3M)
2. Calculate the isothermal compressibility of air at a pressure of 0.5 atm. (2 M)
3. Define characteristic speed of sound and stagnation speed of sound. (3 M)
4. Give the relations between characteristic properties and stagnation properties of a flow.(2 M)
5. Define shock strength and classify strong and weak shocks. (2 M)
6. State the advantages of graphical representation of the solution of a flow problem. (3 M)
7. Using neat schematic sketch, explain the application of nozzles. (3 M)
8. Define critical Mach number and drag – divergence Mach number. (2 M)
9. Write about advantages of delta wing. (2 M)
10. Sketch the surface stream lines on a cone at an AoA. (3 M)

PART B **Max Marks: 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

11. a. Define speed of sound. Derive the expressions for speed of sound I terms of pressure, density and temperature. **(5 M)**
b. Define thermally perfect and calorically perfect gases. Give the equation of state for calorically and thermally perfect gases. **(5 M)**

OR

12. a. Air flows through a duct. The pressure and temperature at station 1 are 0.7 atm and 30^0C, respectively. At a second station, the pressure is 0.5 atm. Calculate the temperature and density at the second station. Assume the flow to be isentropic.
b. State the limitations of air as a perfect gas.
c. Air at 30^0C is compressed isentropically to occupy a volume which is 1/30 of its initial volume. Assuming air as an ideal gas, determine the final temperature.

13. Using energy equation, derive the relation between static properties and stagnation properties of a flow making necessary assumptions.

OR

14. a. Derive the relation between total pressures across normal shock waves. Explain all the symbols used clearly. (5 M)

b. A re-entry vehicle is at an altitude of 15,000 m and has a velocity of 1850 m/s. a bow shock wave envelops the vehicle. Neglecting disassociation, determine the static and stagnation pressure just behind the shock wave on the vehicles center line where the shock is assumed to be normal shock. Assume that air behaves as perfect gas with γ = 1.4 and R = 287 J/kg - K. (5 M)

15. A uniform supersonic stream with M_1 = 3.0, p_1 = 1 atm and T_1 = 288 K encounters a compression corner which deflects the flow stream by an angle of 20^0C. Calculate the shock wave angle and p_2, $T_{2,}$, M_2, p_{o2}, T_{02} behind the shock wave. All the symbols used are standard. Comment on the result if the deflection angle is increased keeping Mach number constant and the Mach number is increased with deflection angle constant, while the remaining parameters are the same.

OR

16. A flat plate is kept at 15^o angle of attack to a supersonic flow at Mach number 2.4. Solve the flow field around the plate and determine the inclination of slipstream direction using shock expansion theory.

17. a) Define linearization. Obtain an expression for linearized pressure coefficient.

b) Obtain an expression for pressure coefficient for a linearized subsonic flow over a two dimensional profile.(Prandtl-Glauert rule).

c) The low-speed lift coefficient for an NACA 2412 airfoil at an angle of attack of 4^0 is 0.65. Using the Prandtl-Glauert rule, calculate the lift coefficient for M_∞ = 0.7.

OR

18. a) What is diffuser? Sketch a nozzle with conventional supersonic diffuser

b) A supersonic wind tunnel is designed is designed to produce flow at Mach 2.4. at standard atmospheric conditions. Calculate (i) the exit to throat area ratio of the nozzle (ii) Reservoir pressure and temperature.

19. Describe briefly about components of wind tunnel and flow measurement devices.

OR

20. Write a short note on Laser Doppler anemometer.

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III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING
HIGH SPEED AERODYNAMICS - II (R15)
MODEL PAPER – III
MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1. Define isentropic flow. State the relation between flow properties in an isentropic flow. (2M)
2. At the nose of the missile in flight, the pressure and temperature are 5.6 atm and 850^0C, respectively. Calculate the density and specific volume. (3 M)
3. What are the governing equations for steady one – dimensional flow? (2 M)
4. For a flow through a variable area duct, give the relation between Area and velocity of the flow. What are the assumptions made in deriving this equation (3 M)
5. Focus on the formation of three – dimensional shock waves. (2 M)
6. State the difference between flow over wedges and cones. (3 M)
7. Give the governing equations for quasi 1- D flow. (2 M)
8. Give the three echelons of transonic inviscid flow theory. (3 M)
9. What is kinematic similarity of flow. (2 M)
10. What types of experiments are carried out by suing wind tunnel? (3 M)

PART B **Max Marks: 50**

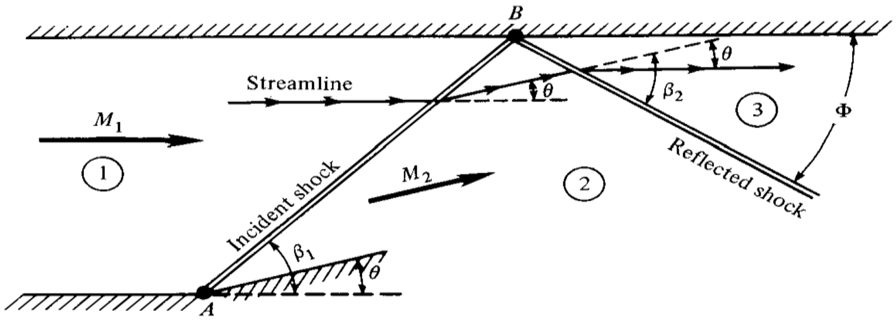
i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

11. Air flows isentropically through a nozzle. If the velocity and the temperature at the exit of the nozzle are 390 m/s and 28^oC, respectively, determine the Mach number and Stagnation temperature at the exit. What will be the Mach number just upstream of a station where the temperature is 92.5^oC.

OR

12. Derive the normal relations for a perfect gas. Make necessary assumptions and explain the nomenclature.
13. Consider a supersonic flow at Mach 2.8 with a static pressure and temperature of 1 atm and 519^0 R, respectively. The flow passes over a compression corner with a deflection angle of 16^0. The oblique shock generated at the corner propagates into the flow, and is incident on a horizontal wall. Calculate the angle Φ made by the reflected shock wave with respect to the wall, and the

Mach number, pressure and temperature behind the reflected shock. Assume that the flow is parallel to the horizontal after moving across the reflected shock.



OR

14. a. Write about shock polar and pressure deflection diagrams.
    b. Explain about prandtl-meyer expansion waves.

15. a) Define Area rule and its importance in designing supersonic aircraft.
    b) Define critical Mach number. Obtain an expression for pressure coefficient at critical Mach number.

OR

16. a) Derive the linearised supersonic flow governing equation.
    b) At $\alpha = 0^0$, the minimum pressure coefficient for an NACA 0009 airfoil in low-speed flow is -0.25. Calculate the critical Mach number for this airfoil using Prandtl-Glauert rule and Karman-Tsien rule.
17. Explain about the method of characteristics for supersonic wind tunnel design.

OR

18. Explain about Quasi one dimensional flow and the area mach relation with over and under expanded flows.
19. Write a short note on Blow down and indraft tunnel layouts and their design features.

OR

20. Write a short note on advantages and disadvantages of wind tunnel.

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III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING
HIGH SPEED AERODYNAMICS - II (R15)
MODEL PAPER – IV
MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1. Define stagnation conditions and characteristic conditions. (2M)
2. Give the 3 basic governing equations of fluid flow . (3 M)
3. Give the laplace equation in terms of speed of sound. (2 M)
4. Show that the mass flow rate across a stream tube in compressible flow field is inversely proportional to its sectional area. (3 M)
5. Consider a supersonic flow at Mach 2.8 over a compression corner with a deflection angle of 15^0. If the deflection angle is doubled, what is the increase in shock strength? Is it also doubled? Comment. (2 M)
6. Give Prandtl – Meyer function and its significance. (3 M)
7. Define linearization. Give the small perturbation equation. (2 M)
8. Give the expression for C_{pcr} and necessary deductions. (3 M)
9. Define region of influence and domain of independence. (2 M)
10. Define dynamic similarity of flows. (3 M)

PART B **Max Marks: 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

11. Define Mach number and its importance. Using neat sketches, explain the flow pattern in various flow regimes.

OR

12. a. At a given point in the high speed flow over the airplane wing, the local Mach number, pressure and Temperature are 0.7, 0.2 atm and 250 K respectively. Calculate the values of p_o, T_o, p^*, T^*, a^* at this point. The symbols used are according to the standard convention. (5M)

    b. Consider a normal shock wave in the flow. The upstream conditions are given by M_1=3, p_1 = 1 atm and ρ_1 = 1.23 kg/m^3. Calculate the downstream values p_2, T_2, M_2, u_2, p_{o2}, T_{o2}**.** The symbols used are according to the standard convention. (5M)

13. Using neat sketches, explain the mathematical/graphical procedures for solving the flow problem
    a. When the shocks of opposite families intersect
    b. When the shocks of same family intersect

OR

14. Consider an infinitely thin flat plate at an angle of attack of 20^0 in a Mach 3 free – stream. Calculate the magnitude of flow direction angle φ downstream the trailing edge.
15. Derive the linearized pressure coefficient for supersonic flows.

OR

16. A flat plate is kept at 15^o angle of attack to a supersonic flow at Mach number 2.4. Solve the flow field around the plate and determine the inclination of slipstream direction using shock expansion theory.

17. a. Derive the Area – Mach relation for the variable area ducts like a nozzle.
    b. Consider the purely subsonic flow in a convergent – divergent duct. The inlet, throat and the exit area are 1 m^2, 0.7 m^2 and 0.85 m^2 respectively. If the inlet Mach and pressure are 0.3 and 0.8 x 10^5 N/m^2, respectively, then calculate: M and p at the throat and exit.

OR

18. Explain about the role of leading edge extension to improve the performance of aircraft at high angle of attack.

19. Write a short note on Non dimensional parameters and explain about its importance in wind tunnel testing.

OR

20. Discuss briefly about schileren flow visualization technique with neat sketch.

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III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING
HIGH SPEED AERODYNAMICS - II (R15)
MODEL PAPER – V
MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1. Define the terms continuum flow, free – molecular flow and low density or rarefied flows. (3 M)
2. Define the terms Universal gas constant, Gas constant and Boltzmann constant. (2 M)
3. Explain in simple steps, how supersonic stream is generated in a Convergent – divergent nozzle. (3 M)
4. Give the relation of change in entropy of the flow across a normal shock wave. (2 M)
5. Define flow deflection angle, shock angle and mach angle. (2 M)
6. How does an expansion fan or a shock wave behave when they encounter a free boundary? Illustrate the diamond wave pattern using neat sketch. (3 M)
7. State area – rule and define super critical airfoil. (3 M)
8. Give the expressions used for correcting Prandtl – glauret rule. (2 M)
9. Give the expression for pressure coefficient in linearised supersonic flow. (2 M)
10. Define transonic drag. (3 M)

PART B **Max Marks: 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

11. a. Define compressibility. (3M)
    b. Explain briefly about changes in flow properties due to one dimensional flow with heat addition and friction. (7M)

OR

12. A ramjet flies at 11 km altitude with a flight Mach number of 0.9. In the inlet diffuse, the air is brought to the stagnation condition so that it is stationary just before the combustion chamber. Combustion takes place at constant pressure and a temperature increase of 1500^0C takes place. The combustion products are then ejected through the nozzle.
    a. Calculate the stagnation pressure and temperature.
    b. What will be the nozzle exit velocity? (**refer RathaKrishnan, chapter 4)**
13. a. Using neat sketch, explain the change of properties behind a oblique shock wave. (5 M)

b. Upstream of the oblique shock wave $M_1 = 3$, $p_1 = 0.5$ atm and $T_1 = 200$ K. Calculate the effect of wave angle on the down stream properties M_2, p_2, T_2, u_2, ρ_2 for 15 and 30 degrees. (5 M)

OR

14. a. Write short notes on wave reflection from free boundary.
b. Air flows at Mach 4.0 and pressure 10^5 N/m^2 is turned abruptly by a wall into the flow with a turning angle of 20^o. If the shock is reflected by another wall determine the flow properties M and ρ downstream of the reflected shock.

15. Derive the velocity potential equation.

OR

16. Write a short note on Critical Mach number, Drag divergence number and supercritical airfoil.

17. Derive the expression for mass flow rate of a calorically perfect gas through a choked nozzle. Explain the terms used clearly. $\dot{m} = \frac{p_o A^*}{\sqrt{T_o}} \sqrt{\frac{\gamma}{R}\left(\frac{2}{\gamma+1}\right)^{\frac{\gamma+1}{\gamma-1}}}$

OR

18. a. Write a short note on vortex lift and its effect.
b. Explain briefly about flow behavior over delta wings at high angle of attack.

19. Write a short note on Shadow graph flow visualization technique with neat sketches

OR

20. Discuss briefly about the wind tunnel balances to measure the forces and moments.

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III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING

AIRCRAFT STABILITY AND CONTROL (R15)

MODEL PAPER – I

Total marks: 75

PART A **Marks: 25**

i. All questions in this section are compulsory
ii. Answer the question in brief.

1) Explain the termsStatic and Maneuver Stability? [3M]
2) What is the equilibrium condition of an aircraft? [2M]
3) What is stability derivatives? [3M]
4) Explain angle of yaw and angle of side slip? [2M]
5) Define Stick fixed neutral point? [3M]
6) Explain about one engine inoperative condition [3M]
7) Define pitch rate, and pitch damping? [2M]
8) Write down the expressions for stability derivatives of an airplane in pitch, yaw and roll. [3M]
9) Define damping ratio and natural frequency [2M]
10) What are the forces acting on a flight with respective to stability and control? [2M]

PART B **Marks: 5x10= 50**

Answer only one question among the two questions in choice.

i. Each question answer (irrespective of the bits) carries 10M.

1) Explain the significance of Routh's discriminant.

Or

2) Drive an expression for the tail contribution to the pitching moment of an aircraft (assume i_{t1} is the wing setting angle and i_{t2} is the tail setting angle).
3) Derive an expression for aircraft side force with respect to the side slip, rate of side slip , roll rate , yaw rate, aileron , rudder deflections

Or

4) Define stability derivatives with the representation of aerodynamic forces and moments
5) Derive the equation for elevator free factor with required sketches

Or

6) Explain the use of hinge moments in determining stick force to be applied by the pilot in unaccelerated flight of the airplane .Show that with $dF_s/dv<0$,the airplane statically unstable
7) Derive the equations of motion of a rigid body subjected to inertial forces and moments illustrate with sketches

Or

8) With a neat sketch show the axes system associated with an airplane

9) Describe the motion of airplane after it has entered in to spinning. What are the causes of airplane getting in to spin? How does the pilot make recovery from spin

Or

10) Define the term longitudinal dynamic stability of the airplane. Explain if an airplane when possessing static longitudinal stability will as well be dynamically stable. Make use of the stability quartic equation and sketches accompanied by plots illustrating typical modes of motion in support of your answer

III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING

AIRCRAFT STABILITY AND CONTROL (R15)

MODEL PAPER – 2

Total marks: 75

<u>PART A</u> **Max Marks: 25**

1. Define static stability and dynamic stability. [2M]
2. What do you mean by degree of freedom? [3M]
3. What is meant by aileron reversal? [2M]
4. What is snaking. Sketch the snaking motion of an aircraft. [2M]
5. Difference ranging from stick fixed and stick free. [3M]
6. What is meant by `Weather Cock Stability'? [2M]
7. What are the condition for longitudinal static stability? [2M]
8. How is dihedral useful for lateral stability. [3M]
9. What is meant by roll mode? [3M]
10. What is meant by phugoid oscillation? Discuss. [3M]

<u>PART B</u> **Marks: 5x10= 50**

Answer only one question among the two questions in choice.

i. Each question answer (irrespective of the bits) carries 10M.

1) Explain the significance of Routh's discriminant.

Or

2) Discuss in detail the power effects on longitudinal static stability.

3) Write short notes on. Variable incidence tail plane and Adverse Yaw

Or

4) What is the coupling ranging from rolling and yawing moments, discuss with suitable examples.
5) Explain stick force per g in detail

Or

6) Derive the neutral point equation for stick free condition with respective fig
7) Explain the position and orientation of an aircraft relative to earth and describe it in terms of Euler's angles

Or

8) Derive the equation of aircraft force equations and moment equations
9) Explain the following phenomenon (a) Dutch roll (b) Spiral instability (c) spin

Or

10) Write a short notes on (a) stability derivatives in longitudinal dynamic stability and (b) Stability quartic

III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING
AIRCRAFT STABILITY AND CONTROL (R15)
MODEL PAPER – 3

Total marks: 75

PART A **Marks: 25**

1) What is the criterion for static longitudinal stability [3M]
2) Graphically represent a system which is statically stable but dynamically unstable [3M]
3) Define aileron reversal [2M]
4) Explain about lateral control [2M]
5) Define cross wind landings [3M]
6) Plot the variation of hinge moment with control deflections & hinge moment with angle of attack [3M]
7) Define stability axis system [2M]
8) Define Euler angle rates and body axis rates [3M]
9) What is meant by Dutch roll mode [2M]
10) Explain short period oscillation [3M]

PART B **Marks: 5x10= 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

1) Explain in detail about the elevator control power with sketches .Derive the equation $(dc_m/dc_l)_{tail} = -a_t v_{\eta t}$

Or

2) Derive the equations for maneuverability – the elevator angle and control force required to hold the airplane in a steady pull-up with load factor with required sketches
3) Describe the derivatives of yawing moment of an aircraft with respect to the side slip, rate of side slip, roll rate, yaw rate , aileron , rudder deflections

Or

4) Explain the difference between aerodynamic coefficients and aerodynamic derivatives .Give four pairs of examples with explanation
5) Explain stick force gradients in detail

Or

6) Derive the equation for the control effectiveness of elevator

7) Derive the longitudinal linearized equations of motion with small perturbation approach

Or

8) With the first–order approximation of applied aero forces and moments get the equations for longitudinal and lateral – directional perturbed forces and moments
9) Describe Dutch roll and spiral instability

Or

10) Explain how stability quartic helps in studying the dynamic stability of an aircraft

III B.TECH I SEMESTER – AERONAUTICAL ENGINEERINGAIRCRAFT STABILITY AND CONTROL (R15)
MODEL PAPER – 4

Total marks: 75

PART A **Marks: 25**

1) Write a short notes on control of aircraft [2M]
2) Define neutral point, Balance or Equilibrium [3M]
3) How is dihedral useful for lateral stability [2M]
4) Define yawing moment [2M]
5) Write down the equation for elevator floating angle [3M]
6) Plot the variation of hinge moment with control deflections & hinge moment with angle of attack [3M]
7) Explain lateral –directional applied forces and moments [3M]
8) Explain the four step approach summarizes the linearization technique [3M]
9) Write a short notes on two degree of freedom Dutch roll approximations [2M]
10) Write a short notes on two-degree of freedom spiral approximation [2M]

PART B **Marks: 5x10= 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

11) Derive the equation for contribution of wing of a aircraft pitching moment with neat sketches

Or

12) Define static margin , elevator power , and what is control effectiveness factor
13) Explain about the representation of aerodynamic forces and moments

Or

14) Derive the equation for aircraft side force with required figs
15) Define hinge moments of aerodynamic surfaces. Derive an expression for the floating angle of an elevator

Or

16) Define the terms 'floating tendency and restoring tendency'. What is floating of a control surface? Describe ways and means to alleviate or control these hinge moments by an arrangement known as set – back hinge line
17) Derive a six step procedure that used to build up the response side of the three moment equations

Or

18) Summarize the small perturbation approach and develop the linearized aircraft equations of motion

19) Explain about spiral mode and roll subsidence

Or

20) Discuss the dynamic stability aspects of an aircraft considering its linearized longitudinal equations of motion being analyzed under three- degrees, two-degrees and one degrees of freedom assumptions

III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING
AIRCRAFT STABILITY AND CONTROL (R15)
MODEL PAPER – 5

Total marks: 75

PART A **Marks: 25**

1) What is the criterion for static longitudinal stability [3M]
2) Graphically represent a system which is statically stable but dynamically unstable [3M]
3) Define aileron reversal [2M]
4) Define angle of yaw and angle of side slip [2M]
5) Define hinge moment and write down the expression for hinge moment coefficient [3M]
6) Explain about one engine inoperative condition [3M]
7) Define body axis system [2M]
8) Explain about the coordinate transformation [3M]
9) What is meant by phugoid oscillation [3M]
10) What is meant by roll mode [2M]

PART B **Marks: 5x10= 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

1) Explain the contribution of fuselage of aircraft pitching moment

Or

2) Derive the axis component of entire airplane and explain about the basic longitudinal Forces with required sketches

3) Explain about the estimation of aerodynamic force and moment derivatives of aircraft

Or

4) Explain about the lateral directional static stability and aero elasticity

5) Explain stick force per g in detail

Or

6) Derivethe neutral point equation for stick free condition with respective fig

7) Explain the position and orientation of an aircraft relative to earth and describe it in terms of Euler's angles

Or

8) Derive the equation of aircraft force equations and moment equations

9) Explain the following phenomenon (a) Dutch roll (b) Spiral instability (c) spin

Or

10) Write a short notes on (a) stability derivatives in longitudinal dynamic stability and (b) Stability quartic

MALLA REDDY COLLEGE OF ENGINEERING ANDTECHNOLOGY
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III B.TECH I SEMESTER – AERONAUTICAL ENGINEERING
MECHANISMS AND MECHANICAL DESIGN (R15)
MODEL PAPER – I
MAXIMUM MARKS: 75

PART A **Max Marks: 25**

i. All questions in this section are compulsory
ii. Answer in TWO to FOUR sentences.

1. Explain the term kinematic link.
2. Give examples for "single and double slider crank chains".
3. What is instantaneous center?
4. Write "Three centers in line theorem".
5. Explain the term "Plane of Spinning".
6. Define the terms: Steering, Pitching and Rolling
7. Define the following terms as applied to cam
   (a) Base circle, (b) Pitch circle, (c) Pressure angle
8. What are the different types of motion with which a follower can move?
9. Define "Law of gearing".
10. Define the terms: Module, Diametral pitch and Circular pitch.

PART B **Max Marks: 50**

i. Answer only one question among the two questions in choice.
ii. Each question answer (irrespective of the bits) carries 10M.

1. With neat sketch explain completely constrained motion, incompletely constrained motion and successfully constrained motion.

(OR)

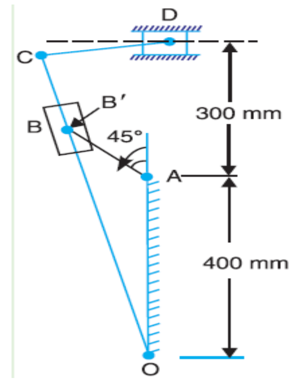
2. a) Briefly explain any two inversions of single slider crank chain.
   b) With neat sketch explain briefly Oldham's coupling and scotch yoke mechanism.

3. In a 4 bar mechanism, the link AB rotates at 36rad/s. The length of the links are AB=200mm, BC=400mm, CD=450mm and AD=600mm. AD is the frame. At the instant the crank is at right angles to AD find
   i. Velocity of the midpoint of BC and a point on CD, 100mm from the pin connecting the links CD and AD
   ii. Angular acceleration of BC and CD

(OR)

4. A mechanism of a crank and slotted lever quick return motion is shown in Fig. If the crank rotates counter clockwise at 120 r.p.m., determine for the configuration shown, the velocity and acceleration

of the ram D. Also determine the angular acceleration of the slotted lever. Crank, AB = 150 mm; Slotted arm, OC = 700 mm and link CD = 200 mm.



5. An aero plane makes a complete half circle of 50 m radius towards left, when flying at 200 km/hr. The rotary engine and propeller of the plane has a mass of 400 kg and radius of gyration of 0.3 m. The engine rotates at 2400 rpm clockwise when viewed from rear. Find the gyroscopic couple on aircraft and state its effect on it.

(OR)

6. a. Discuss the effect of the gyroscopic couple on a two wheeled vehicle when taking a turn.
   b. Describe the gyroscopic effect on sea going vessels.
7. A cam is to be designed for a knife edge follower with the following data :
   1. Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion.
   2. Dwell for the next 30°.
   3. During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion.
   4. Dwell during the remaining 180°.
   Draw the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240r.p.m.

(OR)

8. A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below:
   1. To raise the valve through 50 mm during 120° rotation of the cam;
   2. To keep the valve fully raised through next 30°;
   3. To lower the valve during next 60°; and
   4. To keep the valve closed during rest of the revolution i.e. 150°;
   The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm.
   Draw the profile of the cam when the line of stroke of the valve rod passes through the axis of the cam shaft, The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion. Determine the maximum acceleration of the valve rod when the cam shaft rotates at 100r.p.m.

9. a. Explain different terms used in gears with a neat sketch.
   b. Derive the condition for constant velocity ratio of toothed wheels.

(OR)

10. What is gear train? Explain different types of gear trains.

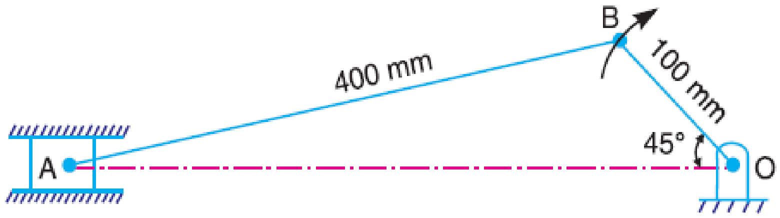


Fig. 1

15. Explain the effect of gyroscopic couple on an aircraft.

(OR)

16. Explain the Effect of gyroscopic couple on a naval ship during steering and rolling.
17. A cam operating a knife-edged follower has the following data:
    (a) Follower moves outwards through 40 mm during 60° of cam rotation.
    (b) Follower dwells for the next 45°.
    (c) Follower returns to its original position during next 90°.
    (d) Follower dwells for the rest of the rotation.
    The displacement of the follower is to take place with simple harmonic motion during both the outward and return strokes. The least radius of the cam is 50 mm. Draw the profile of the cam when 1. The axis of the follower passes through the cam axis, and 2. The axis of the follower is offset 20mm towards right from the cam axis. If the cam rotates at 300r.p.m. determine maximum velocity and acceleration of the follower during the outward stroke and the return stroke.

(OR)

18. A cam rotating clockwise with a uniform speed is to give the roller follower of 20 mm diameter with the following motion:
    (a) Follower to move outwards through a distance of 30 mm during 120° of cam rotation;
    (b) Follower to dwell for 60° of cam rotation;
    (c) Follower to return to its initial position during 90° of cam rotation; and
    (d) Follower to dwell for the remaining 90° of cam rotation.
    The minimum radius of the cam is 45 mm and the line of stroke of the follower is offset 15mm from the axis of the cam and the displacement of the follower is to take place with simple harmonic motion on both the outward and return strokes. Draw the cam profile.

19. Derive the speed ratio for compound gear train.
    Two parallel shafts, about 600mm apart are to be connected by spur gears. One shaft is to run at 360r.p.m. and the other at 120r.p.m. Design the gears, if the circular pitch is to be 25mm.

(OR)

20. Derive the speed ratio for reverted gear train.
    The speed ratio of the reverted gear train, as shown in Fig., is to be 12. The module pitch of gears A and B is 3.125 mm and of gears C and D is 2.5 mm. Calculate the suitable numbers of teeth for the gears. No gear is to have less than 24 teeth.

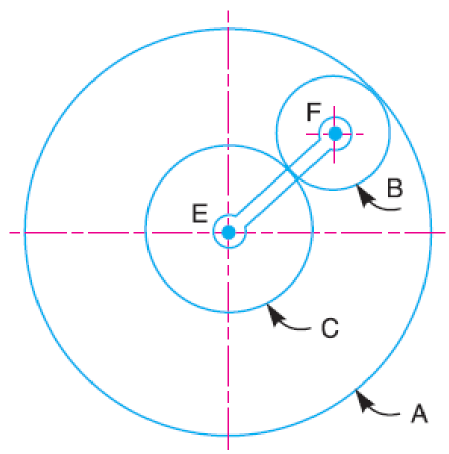
(OR)

18. A flat faced reciprocating follower has the following motion:
(i) The follower moves out for 80° of cam rotation with uniform acceleration and retardation, the acceleration being twice the retardation.
(ii) The follower dwells for the next 80° of cam rotation.
(iii) It moves in for the next 120° of cam rotation with uniform acceleration and retardation, the retardation being twice the acceleration.
(iv) The follower dwells for the remaining period.
The base circle diameter of the cam is 60 mm and the stroke of the follower is 20 mm. The line of movement of the follower passes through the cam centre. Draw the displacement diagram and the profile of the cam very neatly showing all constructional details.

19. Derive the velocity ratio for epicyclic gear train by using tabular method.
In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300r.p.m. in the clockwise direction, what will be the speed of gear B?

(OR)

20. An epicyclic gear consists of three gears A, B and C as shown in Fig. The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 r.p.m. If the gear A is fixed, determine the speed of gears B and C.



determine maximum velocity and acceleration of the follower during the outward stroke and the return stroke.

(OR)

18. A cam with 30mm as minimum diameter is rotating clockwise at a uniform speed of 1200r.p.m. and has to give the following motion to a roller follower 10 mm in diameter:
(a) Follower to complete outward stroke of 25 mm during 120° of cam rotation with equal uniform acceleration and retardation ;
(b) Follower to dwell for 60° of cam rotation;
(c) Follower to return to its initial position during 90° of cam rotation with equal uniform acceleration and retardation;
(d) Follower to dwell for the remaining 90° of cam rotation.
Draw the cam profile if the axis of the roller follower passes through the axis of the cam. Determine the maximum velocity of the follower during the outstroke and return stroke and also the uniform acceleration of the follower on the out stroke and the return stoke.

19. Derive the equations for Length of path of contact and Length of arc contact,
A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio.

(OR)

20. A pair of gears, having 40 and 20 teeth respectively, are rotating in mesh, the speed of the smaller being 2000 r.p.m. Determine the velocity of sliding between the gear teeth faces at the point of engagement, at the pitch point, and at the point of disengagement if the smaller gear is the driver. Assume that the gear teeth are 20° involute form, addendum length is 5 mm and the module is 5 mm. Also find the angle through which the pinion turns while any pairs of teeth are in contact.