Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VI SEMESTER B.TECH. (AERONAUTICAL ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL 2017

SUBJECT: AIRCRAFT DESIGN-II [AAE 3201]

REVISED CREDIT SYSTEM
(22/04/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. What are statically determinate and indeterminate structures? Explain with examples. **(3)**

1B. Name the alloys used in aircraft construction. Also discuss their properties. **(3)**

1C. Fig.(i) shows an aircraft landing on a navy aircraft carrier and being arrested by a cable pull T on the airplane arresting hook. If the airplane weight is 12000 lbs and the airplane is given a constant acceleration of 112.7 ft/sec^2, find the hook pull T, the wheel reaction R and the distance d between the line of action of hook pull and the airplane c.g. If the landing velocity is 60 mph, what is the stopping distance? **(4)**

2A. With the help of neat sketches explain the different attitudes of the airplane that are specified by the government aviation agencies for the design of landing gear. **(3)**

2B. Fig.(ii) shows the projections of the landing gear configurations on the VS and VD planes. The gear unit is attached to the supporting structure at points F, H & G. Fittings at F & H are designed to resist no bending moment. Draw the space force diagram. **(3)**

2C. For the above problem (2B), also find the reactions at points F, H & G and resisting torsional moment (T_E). **(4)**

3A. Fig.(iii) shows a typical upper, outer panel wing beam of a biplane. Determine the maximum negative bending moment between points 1 & 2. **(3)**

3B. For the above problem (3A), also find the bending moment at a point 10 inches left of point 2. **(3)**

3C. Show that the deflection function $w = A(x^2y^2 - bx^2y - axy^2 + abxy)$ is valid for a rectangular plate of sides *a* and *b*, built in on all four edges and subjected to a uniformly distributed load of intensity *q*. If the material of the plate has a Young's modulus *E* and is of thickness *t*, determine the distributions of bending moment along the edges of the plate. **(4)**

4A. Briefly explain about the characteristic graphs that are essential to the airfoil selection process **(3)**

4B. Explain the effect of aspect ratio on the following: Lift curve slope, Induced drag, span and structural weight. **(3)**

4C. Select a NACA airfoil section for the wing for a jet non-maneuverable GA aircraft with the following characteristics: **(4)**
m_{TO} = 4000 kg, S = 30 m^2, V_{cruise} = 250 knot (at 3000 m), V_{stall} = 65 knot (sea level)
The high lift device (split flap) will provide C_L = 0.8 when deflected.
(Please refer table. (i) after obtaining C_{li} & $C_{lcruise}$)

5A. Explain the effect of wing sweep on the following: Lift curve slope, C_{Lmax}, induced drag and drag divergence Mach number **(3)**
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5B. Write a short note on NACA Airfoils. (with neat sketches) **(3)**

5C. An aircraft has a wing area of S = 20 m^2, aspect ratio AR = 8, and taper ratio of 0.6. It is required that the 50 percent chord line sweep angle be 30 degrees. Determine tip chord, root chord, mean aerodynamic chord, span, and effective span, as well as leading edge sweep, trailing edge sweep and quarter chord sweep angles. **(4)**

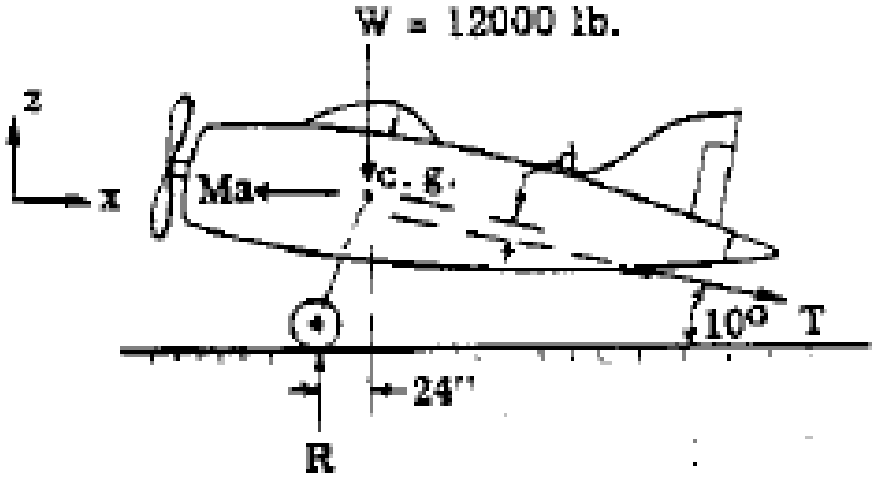


Fig. (i)

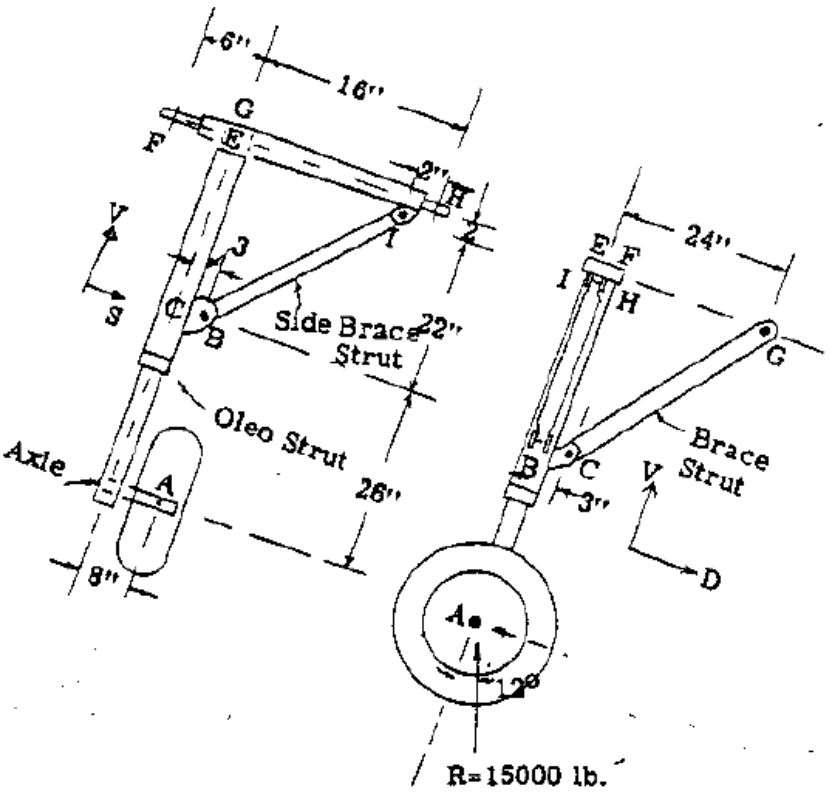
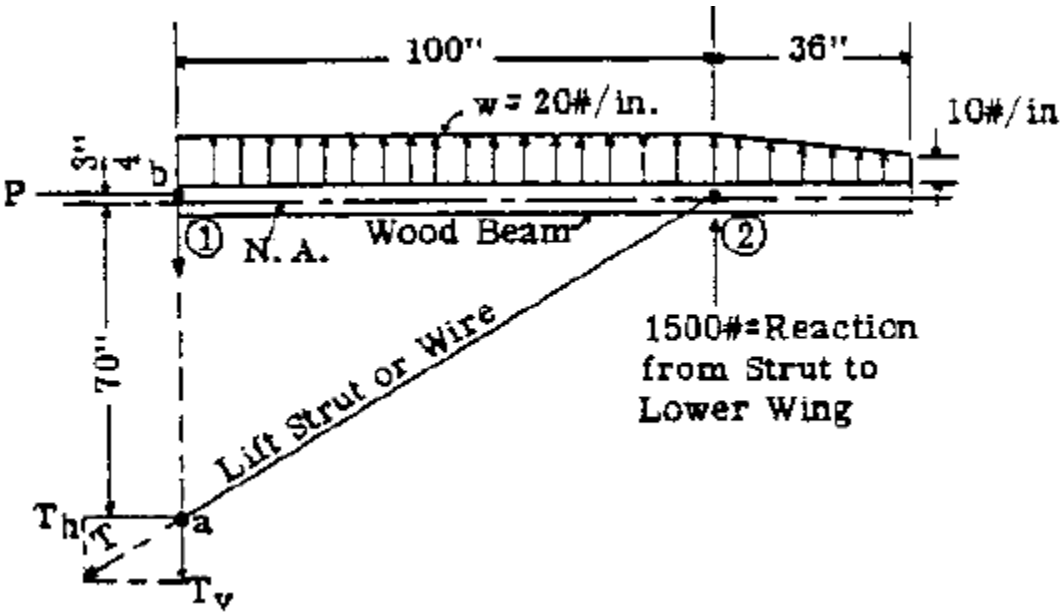


Fig. (ii)



Fig, (iii)

No	NACA	C_{dmin}	C_{mo}	α_s (deg) Flap up	α_o (deg) $\delta_f = 60°$	$(C_l/C_d)_{max}$	Stall quality
1	63_3-218	0.005	-0.028	12	-12	100	Docile
2	64-210	0.004	-0.040	12	-13	75	Moderate
3	66_1-212	0.0032	-0.030	12	-13	86	Sharp
4	66_2-215	0.0035	-0.028	14	-13.5	86	Sharp
5	65_3-218	0.0045	-0.028	16	-13	111	Moderate

Table. (i)