GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Aeronautical Engineering
SUBJECT NAME: Aircraft Design- I
SUBJECT CODE: 2170101
B.E. 7thSEMESTER

Type of course: Engineering Science

Prerequisite: Basics of Flight Mechanics, Aerodynamics, Propulsion, Aircraft Structure.

Rationale: Aircraft Design is one of the core areas in the field of aviation. The concepts of Aircraft Design are very important in core industry.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction of conceptual design of a flight vehicle design:** Aircraft purpose, Payload, cruise & Maximum Speed, Range, Endurance, take off and landing distance, design process, conceptual design.	8	16.66
2	**Preliminary estimate of take-off weight:** Fuel fraction estimate, total takeoff weight, spread sheet of take off weight estimate.	3	6.25
3	**Wing loading and Thrust/ Weight selection:** Wing loading effect on takeoff, landing, climb, acceleration, range, combat, flight ceiling & glide rate.	5	10.41
4	**Fuselage design:** Volume considerations, Aerodynamic considerations, drag estimation.	4	8.33
5	**Horizontal and Vertical Tail design:** Tail arrangement, horizontal and vertical tail sizing, tail plan form shape, Airfoil section type, tail placement.	6	12.5
6	**Engine selection:** Propulsion selection, No's of engines, Engine ratings, turbojet engine sizing, propulsion system.	5	10.41
7	**Take off and landing distance design:**	2	4.16
8	**Structural design and material selection:** Material selection, structural loads, internal structure design, material selection.	5	10.41

9	**Static Stability and control:** Refined weight estimate, static stability.	**2**	4.16
10	**Basics of helicopter design:** Principle of helicopter operations, Main Rotor design, airfoils for rotor blades, tail rotor design, Horizontal and vertical stabilizers, control systems, The turbine engine, different configurations of helicopter.	**8**	16.66

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
35%	**25%**	**20%**	**15%**	**5%**	**0%**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Design of Aircraft, By Thomas C Corke
2. Aircraft Conceptual Design Analysis, By Denis Howe
3. Aircraft Design- a conceptual approach by D. P. Raymer

Course Outcome:

After learning the course the students should be able to:

- To understand about the standard aircraft design process.
- To know how to estimate weight of aircraft while designing.
- To understand fundamentals of aircraft configuration selection.
- To know how to choose engine/s and locate them.
- To locate structural members in particular configuration

List of Experiments:

1. To prepare configuration of aircraft as per given data and mission profile.
2. To determine maximum Takeoff Weight, Basic empty weight, fuel weight, fuel volume, maximum zero fuel weight, maximum ramp weight.
3. To deter mine Thrust/ weight ratio or Power loading and wing loading.
4. To select type and number of engines.
5. Determine wing dimensions and plot on the drawing sheet using proper scale.
6. Determine wing dimensions and plot on the drawing sheet using proper scale.
7. Prepare fuselage geometry as per payload shape, weight and Volume.
8. To prepare tail plane geometry after determining tail size.
9. Prepare landing gear/ under carriage geometry of your design.
10. Prepare all primary and secondary control surfaces possible for your aircraft configuration.

Design based Problems (DP)/Open Ended Problem:

Apart from above experiments a group of students has to undertake one open ended problem/design problem.

Few examples of the same are given below.

1. Make a scale model of an aircraft you have designed in Aircraft Design-I subject.

Major Equipment:

Supersonic and Subsonic Wind tunnel, basic model making tools.

List of Open Source Software/learning website: http://nptel.iitm.ac.in/courses.php

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.