LESSON PLAN

1. Course Title : Aircraft Structural Mechanics
2. Course Code : AEC2212
3. Course Faculty : S. V. Karthikeyan
4. Theory/Practical: Theory
5. Semester : IV
6. Academic Year: 2018-19
7. Department: Aerospace Engg.,
8. No. of Credits :4

9. Course Learning Objectives:

To understand the theoretical concepts of material behavior with particular emphasis on their elastic property

10. Course pre-requisites:

Engineering Mechanics, Solid Mechanics

11. Schedule of teaching and learning

As per Annexure-I

12. Course material and References

1. James M Gere & Barry J. Goodno, "Mechanics of Materials, Cenage Learning",7th Edition, 2009.

2. THG Megson, "Aircraft Structures for Engineering Students", Elsevier (BH), 4th Edition, 2007.

3. C.T. Sun, "Mechanics of Aircraft Structures", 2nd Edition, John Wiley & Sons.2006.
4. R.C. Hibbeler, "Structural Analysis", 5th Edition, Prentice-Hall, 2002.
5. B.C.Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Mechanics of Materials",Firewall media, 2002.
6. Craig, R.R., "Mechanics of Materials", John Wiley & Sons, New York, 1996.
7. R.S.Khurmi, "Strength of Materials", 23rd Edition, S.Chand Limited, 2007.
8. R.K.Rajput, "Strength of Materials:Mechanics of Solid", 4th Edition, S.ChandLimited, 2007.

13. Assessment Scheme:

i) Periodical tests

	Topics	Marks
CAT I	Module I &II&III	60
CAT II	Module III & IV&V	60
End sem	Module I-VI	100

ii) Project Based Learning

Topics	Marks
Review 1	40
Review 2	40
Review 3	40

14. Course Outcome: The student should be able to

- Identify and relate different kinds of load factors experienced in aircraft flight.
- Estimate the load bearing capability of different structural members used in the construction of aircraft.
- Extend the concepts of solid mechanics to in-determinate structural problems.
- Obtain theoretical predictions of structural behavior using energy methods.
- Predict the load bearing capacity of pressure vessels.
- Predict the response of the structural elements subjected to combined loadingusing the theoretical and the graphical method.

Annexure-I

UNIT No	Topics to be covered	Duration in Periods	Teaching method BB/PP/Video
MODULE I	LOADS AND STRUCTURAL COMPONENTS OF V-n Diagram	2	BB/PPT
	Different structural members of aircraft,	2	BB/PPT
	Loads taken by thecomponents general definitions.	2	BB/PPT
MODULE II	STATICALLY DETERMINATE STRUCTURES Plane truss analysis, method of joints,	4	BB/PPT
	method of sections,	4	BB/PPT
	3D trusses.	4	BB/PPT
MODULE III	STATICALLY IN DETERMINATE STRUCTURES Propped Cantilever beams, Fixed-Fixed beams	5	BB/PPT
	Clapeyron's 3 momenttheorem	4	BB/PPT
	Moment distribution method, Maxwell's reciprocal theorem.	3	BB
MODULE IV	COLUMNS Inelastic buckling, Effect of initial curvature, Eccentric loading on columns, South well plot	6	BB/PPT
	Use of energy methods in column, Beam-columns.	4	BB/PPT
MODULE V	ENERGY METHODS -Castigliano's theorems	3	BB/PPT
	Unit load and Dummy load methods, application of	3	BB
	Energy methods to frames, beams, trusses and rings.	4	BB/PPT
MODULE VI	FAILURE THEORY Maximum principle Stress theory, Maximum principle Strain theory,	3	BB
	Shear stresstheory, distortion energy theory, octahedral shear stress theory.	7	BB/PPT
	TOTAL PERIODS	60 Hours	

15. Mapping of coarse outcomes with learning activities and assessments

Course outcomes	Learning activities	Assessments	CAT I* %	CAT II* %	End sem* %
Course outcome 1	Identify and relate different kinds of load factors experienced in aircraft flight.	Assessment test+ Project Based Learning	25		15
Course outcome 2	Estimate the load bearing capability of different structural members used in theconstruction of aircraft.		20		15
Course outcome 3	Extend the concepts of solid mechanics to in-determinate structural problems.		15	15	20
Course outcome 4	Give a theoretical design ofcolumns subjected to various loads.			25	20
Course outcome 5	Obtain theoretical predictions of structural behavior using energy methods.			10	15
Course outcome 6	Acquire knowledge on failure theories and to predict the values of the stress atwhich the structure fails.				15
Project based Learning			40	40	

*% of questions in the question paper relevant to the respective outcomes

Date: 04-01-2019

Head of the Department

Course Faculty

COURSE PLAN

1. Course Title	:Low Speed Aerodynamics	**5. Semester**	: IV
2. Course Code	:AEC 2211	**6. Academic Year**	: 2018-19
3. Course Faculty	**:S.Karthikeyan**	**7. Department**	: Aero
4. Theory / Practical	: Theory	**8. No. of Credits**	: 3

9. Course Learning Objectives:

- To introduce the basic aerodynamic concepts like circulation, vorticity and irrotationality.
- To understand the concepts of super position of elementary flows for linear incompressible flow.
- To introduce the concept of classical thin airfoil theory and Prandtl's lifting line theory for wings.
- Introduce the basics of viscous flow.

10. Course pre-requisites:

- Fluid mechanics

11. Schedule of Teaching and Learning

Sl.No.	Period	Topic	Mode of delivery	Teaching Aids	Reference / Source
[Furnished as Annexure]					

12. Course Material and References

- A list of reference books is given along with lesson plan.

13. Assessment Scheme:

Scheme of assessment	Assessment 1		Assessment 2		End Semester Exam
	CAT 1	Assignment	CAT 2	Assignment	
Marks in percentage	70	30	70	30	100
Internal & End semesterMarks	50				50
Total marks	100				

i) Periodical tests.

There will be twocontinuous assessment tests and the test portions are given below:

Test I	Module I, II& 50% of III Module
Test II	Remaining 50% of Module III, Module IV&V

ii) Tutorial

A set of problems will be given one day in advance. Students will be asked to solve in the class room.

iii) Seminar

Topic: Flow over different types of bodies

iv) Carry Home Exercise

Numerical problems in necessary modules will be given as home exercise.

v) Self Study

- In aerodynamics point of view. identify the suitable airfoils for various types of aircrafts

vi) Content Beyond Syllabus

- Students may be asked to solve and analysis the flow over simple bodies by using software.

14. Course outcomes

21/11/2019

Students will be able to

- Mathematically express the fundamental equations of fluid flow and elementary flow concepts.
- Apply potential flow theory for inviscid, incompressible flow.
- Perform simple calculations for the estimation of the lift characteristics of airfoils using circulation theory/ thin airfoil theory.
- Estimate the induced drag characteristics and lift characteristics of finite wings.
- Perform simple laminar boundary layer calculations.
- Perform simple calculations in wall bounded turbulent boundary layer/ free shear layers.

Date: 07.01.19

Course faculty

Head of the Department 21/1/2019

15. Mapping of course outcomes with learning activities and assessments

Course outcomes	*Learning activities*	*Assessments*	*CAT I * %*	*CAT II * %*	*End sem * %*
Course outcomes 1, 2 & 3	Refer Annexure -Schedule of Teaching and Learning	CAT/Assignment/ End Sem Exam	100	-	45
Course outcomes 3,4 & 5		CAT/Assignment/ End Sem Exam	-	100	45
Course outcome 6		End Sem Exam	-	-	10

**% of marks in the question paper relevant to the respective outcomes*

Date: 07.01.19

Course faculty

Head of the Department

21/1/2019

ANNEXURE (vide item 11)
Schedule of Teaching and Learning

S.No.	Period	Topic	Mode of Delivery	Teaching Aids	Reference / Source
1	2	Over view of **Mod 1.** Continuity, momentum and energy equations	Lecture	Black Board& PPT	John D. Anderson, Jr., Fundamentals of Aerodynamics, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2007.
2	2	Differential equations for streamline, angular velocity, Vortices, circulation. Stream Function, Potential Function, Equi-potential Lines			
3	2	Elementary Flows and their combinations. **(Total 6 periods)**			
4	1	Over view of **Mod 2** Bernoulli's equation, incompressible flow in a duct	Lecture	Black Board & PPT	John D. Anderson, Jr., Fundamentals of Aerodynamics, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2007.
5	1	Pitot tube, pressure coefficient, governing equation for irrotational incompressible flow,			
6	3	Flow over a circular cylinder, D'Alembert's Paradox,			
7	2	lifting flow over a cylinder, KuttaJonkowski Theorem			
8	1	Real flow over smooth and rough cylinder, **(Total 8 Periods)**			
9	2	Over view of **Mod 3** Airfoil nomenclature, airfoil characteristics,	Lecture	Black Board & PPT	John D. Anderson, Jr., Fundamentals of Aerodynamics, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2007.
10	1	Kutta condition,			
11	2	Kutta-Joukowski transformation and its applications			
12	2	Karman Trefftz Profiles,			
13	1	Thin Airfoil theory derivation			
14	1	Applications **of** Thin Airfoil theory **(Total 9 periods)**			

15	2	Over view of **Mod 4** Downwash and induced drag, Vortex Filament, Biot-Savart Law, Helmholtz theorems	Lecture	Black Board & PPT	John D. Anderson, Jr., Fundamentals of Aerodynamics, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2007.
16	2	Bound Vortex and trailing Vortex, Horse Shoe Vortex			
17	2	Prandtl's Lifting Line Theory, lift and induced drag coefficients for elliptic lift distribution,			
18	2	Effect of aspect ratio,			
19	2	Oswald Efficiency factor **(Total 10 periods)**			
20	1	Over view of **Mod 5** Laminar incompressible boundary layer	Lecture	Black Board & PPT	H. Schlitching, Boundary Layer Theory, 7th Edition, McGraw-Hill Book Company, New York, 1979.
21	1	Boundary layer equations, flat plate boundary layer			
22	2	Blasius solution, effect of pressure gradient, similarity in boundary layer			
23	2	Shape factor, laminar separation. **(Total 6 Periods)**			
24	1	Over view of **Mod 6**	Lecture	Black Board & PPT	H. Schlitching, Boundary Layer Theory, 7th Edition, McGraw-Hill Book Company, New York, 1979.
25	1	Turbulent boundary layer on a flat plate			
26	1	Effect of pressure gradient			
27	1	Prandtl's mixing length hypothesis			
28	2	Free shear layers.. **(Total 6 Periods)**			

Total periods: 45

Date: 07.01.19

Course faculty

Head of the Department 21/1/2019

COURSE PLAN

1. Course Title : **Airbreathing Propulsion**
2. Course Code : **AEC 2213**
3. Course Faculty : **Mr. Sri Nithya Mahottamananda**
4. Theory / Practical : **Theory**
5. Semester : **IV**
6. Academic Year : **2018-19**
7. Department : **Aerospace Engineering**
8. No. of Credits : **3**

9. **Course Learning Objectives:**

- To introduce the fundamentals of aircraft propulsion and the working principles of gas turbine engine components.

10. **Course pre-requisites:**

- Knowledge in basics of thermodynamics and Fluid mechanics.

11. **Schedule of teaching and learning**

Sl.No.	Period	Topic	Mode of Delivery	Teaching Aids	Reference / Source

[Refer Annexure- I]

Teaching aids involved:

Traditional	ICT	Experimental	Simulated	Participating	Any other
40	20	20	-	10	10

12. Course material and References

Text Books

1. Saravanamuttoo, H.I.H., Rogers, G.F.C., Cohen H., Paul Straznicky, "Gas Turbine Theory", 6th Edition, Pearson Education Canada, 2008.
2. Hill Philip, Peterson Carl, "Mechanics and Thermodynamics of Propulsion", Addison Wesly, 1992.

References

1. Kroes Michael J, Wild Thomas W, "Aircraft Powerplants", 7th Edition, TataMcGraw Hill, 2010.
2. Mattingly J. D., "Elements of Gas Turbine Propulsion", Tata McGraw Hill, 2005.
3. El-Sayed Ahmed, "Aircraft Propulsion and gas turbine engines", Taylor and Francis (CRC press), 2008.
4. "Rolls Royce Jet Engine", 3rd Edition, 1983.
5. Roy Bhaskar, "Aircraft Propulsion", Elsevier (India), 2008.

13. Assessment Scheme :

i) Periodical tests

There will be three periodical assessment tests and the test portions are given below:

Assessment Scheme	CAT-1	CAT-2	End Semester
CAT	60%	60%	100%
project	40%	40%	------

CAT I — Module I (FUNDAMENTALS OF AERO ENGINES– FUNDAMENTALS)
Module II (PROPELLER THEORY)
Module III (SUBSONIC INTAKES FOR JET ENGINES)

CAT II — Module IV (COMBUSTION SYSTEMS)
Module V (NOZZLES)
Module VI (COMPRESSORS)

ii) **Project**

Periodic review on the project topic selected by the students will be carried out once in every fortnight. The progress of their project work will be evaluated (40%).

iii) **Seminar:** Seminar topic will be assigned to the students those who are interested

Time given for preparation - 1 week

iv) Carry home exercise

Problem from each module will be given as carry home exercise

v) Self study

Module VI Multi - stage axial compressor & Cascade Analysis

vi) Content beyond syllabus

- Module I : Demonstration of jet & piston prop engines

14. **Course outcomes**

Student will be able to

- Get deeper perspective of different types of jet engines used in aircrafts.
- Appreciate the importance of piston engines and realize the necessity of propeller fundamentals.
- Learn major engineering features of jet engine's inlets.
- Visualize the insight of jet engine combustion systems and their complexity.
- Design different types of nozzles and analyze the effect of jet flow interaction with adjacent surfaces.
- Be conversant with compressor performance characteristics and solve basic design problems.

15. Mapping of course outcomes with learning activities and assessments

Course outcomes	Learning activities	Assessments	CAT I * %	CAT II * %	End sem * %
Course outcome 1	Refer Annexure - Schedule of Teaching and Learning	Assessments are based on the performance in the respective continuous assessments and Project	33.3	0	16.66
Course outcome 2			33.3	0	16.66
Course outcome 3			33.3	0	16.66
Course outcome 4			0	33.3	16.66
Course outcome 5			0	33.3	16.66
Course outcome 6			0	33.3	16.66

* % of marks in the question paper relevant to the respective outcomes

Date: 07.01.2019

7/01/19

Course faculty

Head of the Department

9/1/2019

ANNEXURE (vide item 11)

Schedule of Teaching and Learning

S.NO	Period	Topic	Mode of delivery	Teaching Aids	Reference / Source
MODULE I FUNDAMENTALS OF AERO ENGINES					
1	1	Gas turbine Engine development for Aircraft propulsion, Illustration of working of Gas turbine engines	Lecture/Lab Demonstration/ ICT	Black Board / PPT	T_1 & T_2
2	1	the thrust equation and other performance parameters		Black Board / PPT	T_1 & T_2
3	1	Factors affecting thrust, Effect of pressure, velocity and temperature changes of air entering compressor		Black Board / PPT	T_1 & T_2
4	2	Variants of Aircraft jet engines: Turboprop, Turbofan, Turbojet and Turbo shaft		Black Board / PPT	T_1 & T_2
5	1	Performance characteristics and analysis, Ideal and Real Brayton cycles		Black Board / PPT	T_1 & T_2
6	2	Jet engine cycles for aircraft propulsion, Cycle components and efficiency, Real cycle analysis		Black Board / PPT	T_1 & T_2
7	1	Methods of thrust Augmentation.		Black Board / PPT	T_1 & T_2
MODULE II PISTON ENGINES & PROPELLER THEORY					
8	1	IC engines for aircraft application,	Lecture/Lab Demonstration/ ICT	Black Board / PPT	T_1 & T_2
9	1	performance parameters of IC engines		Black Board / PPT	T_1 & T_2
10	1	Supercharging of aircraft IC engines		Black Board / PPT	T_1 & T_2
11	1	Propeller fundamentals		Black Board / PPT	T_1 & T_2

12	2	Propeller aerodynamic theories.		Black Board / PPT	T_1 & T_2
MODULE III SUBSONIC & SUPERSONIC INTAKES					
13	1	Internal flow and stall in subsonic intakes – Boundary layer separation	Lecture/ ICT	Black Board / PPT	T_1 & T_2
14	1	Major features of external flow near a subsonic intake		Black Board / PPT	T_1 & T_2
15	2	Relation between minimum area ratio and external deceleration ratio		Black Board / PPT	T_1 & T_2
16	1	Supersonic inlet flows		Black Board / PPT	T_1 & T_2
17	2	Starting problems in supersonic inlets		Black Board / PPT	T_1 & T_2
18	2	Shock swallowing methods - Modes of inlet operation.			
MODULE IV COMBUSTION SYSTEMS					
19	1	Classification of combustion chamber, combustion mechanism, Combustion parameters:	Lecture/ project	Black Board / PPT	T_1 & T_2
20	1	Aerodynamic pressure losses		Black Board / PPT	T_1 & T_2
21	1	Combustion Efficiency and performance		Black Board / PPT	T_1 & T_2
22	1	Combustion Intensity, Factors affecting combustion chamber performance and design,		Black Board / PPT	T_1 & T_2
23	2	Fuel Injectors, Flame tube cooling, Flame stabilization, Flame holders, Combustion instability		Black Board / PPT	T_1 & T_2

24	1	Numerical Problems		Black Board / PPT	T_1 & T_2
MODULE V NOZZLES					
25	1	Isentropic flow through nozzles	Lecture/ project	Black Board / PPT	T_1 & T_2
26	1	Choking – Area-velocity relation,		Black Board / PPT	T_1 & T_2
27	1	Nozzle types - Effect of back pressure on convergent and converging-diverging nozzles		Black Board / PPT	T_1 & T_2
28	1	over-expanded and under-expanded nozzle exit flows		Black Board / PPT	T_1 & T_2
29	2	Nozzle efficiency – Losses in nozzles - Fixed and variable geometry nozzles – Ejector and Variable area nozzles		Black Board / PPT	T_1 & T_2
30	1	Thrust vector control, Thrust reversal.		Black Board / PPT	T_1 & T_2
MODULE VI RAMJET& SCRAMJET PROPULSION					
31	2	Working principle of ramjet engine – ramjet performance	Lecture/ Assignment	Black Board / PPT	T_1 & T_2
32	2	sample ramjet design calculations		Black Board / PPT	T_1 & T_2
33	1	Introduction to scramjet – preliminary concepts in supersonic combustion		Black Board / PPT	T_1 & T_2
34	1	Integral ram-rocket		Black Board / PPT	T_1 & T_2
35	1	Numerical problems.		Black Board / PPT	T_1 & T_2

B.S. Abdur Rahman
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Deemed to be University u/s 3 of the UGC Act, 1956

COURSE PLAN

1. Course Title	:Aircraft Systems and Instrumentation	5. Semester	:IV
2. Course Code	: AEC2214	6. Academic Year	:2018-19
3. Course Faculty	: Mr.M.Magesh	7. Department	:Aerospace
4. Theory / Practical	: Theory	8. No. of Credits	: 3

9. Course Learning Objectives:

- To impart knowledge of the hydraulic and pneumatic systems components and its operation.
- To introduce the basic knowledge of flight control system and its types.
- To acquaint the students to basic engine components and their applications
- To introduce some knowledge about the cabin comfort system and its applications.
- To gain the basic knowledge of navigational instruments to the students.

10. Course pre-requisites:

- Introduction to Aeronautical Engineering

11. Schedule of teaching and learning

Sl.No.	Period	Topic	Mode of delivery	Teaching Aids	Reference / Source
[To be furnished as Annexure]					

12. Course material and References

1. McKinley, J.L., and Bent, R.D., "Aircraft Maintenance & Repair", McGraw-Hill, 1993.
2. Federal Aviation Administration, "General Hand Books of Airframe and Powerplant Mechanics", U.S. Dept. of Transportation, , the English Book Store, New Delhi1995.
3. Mekinley, J.L. and Bent, R.D., "Aircraft Power Plants", McGraw-Hill, 1993.
4. Pallet, E.H.J., "Aircraft Instruments & Principles", Pitman & Co., 1993.
5. Treager, S., "Gas Turbine Technology", McGraw-Hill, 1997.

13. Assessment Scheme:

i) Continuous Assessment Test (CAT) - 2 (35 Marks)

ii) Assignment - 2 (15 Marks)

14. Course outcomes

Students will be able to

- Demonstrate the ability to design a various system using pneumatic and hydraulic components.
- Keep abreast knowledge on various flight control system and its recent advancements.
- Demonstrate the fundamental understanding of the operation of engine auxiliary systems.
- To understand the various cabin comfort system used in aircraft modern display systems.
- Describe principle behind the operation of various vital parameter displays and its uses in effective conduct of the flight.
- To get basic knowledge of modern aircraft system which helps in understanding the aircraft navigation system better.

15. Mapping of course outcomes with learning activities and assessments

Course outcomes	Assessments	CAT I * %	CAT II * %	End sem * %
Course outcome 1 & 2	Continuous Assessment test, Assignment, Seminar, End sem.	70%		40-45%
Course outcome 3 & 4	Continuous Assessment test, Assignment, Seminar, End sem.	30%	70%	40-45%
Course outcome 5 & 6	Continuous Assessment test, Assignment, Seminar, End sem.		30%	10-20%

*% of questions in the question paper relevant to the respective outcomes

Date: 07-01-2019.

Course faculty

Head of the Department

7/1/19

ANNEXURE (vide item 11)
Schedule of Teaching and Learning

S.No.	Periods	Topic	Mode of Delivery	Teaching Aids	Reference / Source
1	2	MODULE I AIRCRAFT SYSTEMS Hydraulic systems – Study of typical workable systems – components – hydraulic systems controllers – modes of operation — brake system – components.	Lecture/Lab Demonstration	BB/PPT	Mckinley, J.L. and Bent R.D. "Aircraft Maintenance & Repair", McGraw Hill,1993
2	2	pneumatic systems – working principles – typical pneumatic power system			
3	1	Brake system – components			
4	2	landing gear systems – classification			
5	1	shock absorbers– retroactive mechanism			
6	1	MODULE II AIRPLANE CONTROL SYSTEMS: Conventional Systems – modern control systems	Lecture/ Assignment	BB/PPT	Mckinley, J.L. and Bent R.D. "Aircraft Maintenance & Repair", McGraw Hill,1993
7	2	Power assisted and fully powered flight controls – power actuated systems			
8	1	Engine control systems – push pull rod system – operating principles			
9	1	Digital fly by wire systems.			
10	1	Active control technology			
11	1	Auto pilot system			

12	2	**MODULE III** **ENGINE SYSTEMS :** Fuel systems – piston and jet engines – components – multi-engine fuel systems	Lecture/Lab Demonstration	BB/PPT	Mekinley, J.L. and R.D. Bent, "Aircraft Power Plants", McGraw Hill 1993
13	3	Lubricating systems – piston and jet engines.			
14	3	Starting and ignition systems – piston and jet engines.			
15	1	**MODULE IV** **AIR CONDITIONING AND PRESSURIZING SYSTEM :** Basic air cycle systems – vapour cycle systems, boot-strap air cycle system – evaporative vapour cycle systems – evaporation air cycle systems	Lecture/ Assignment/ Lab Demonstration	BB/PPT	Mckinley, J.L. and Bent R.D. "Aircraft Maintenance & Repair", McGraw Hill,1993
16	2	Oxygen systems			
17	2	Fire protection systems			
18	2	Deicing and anti icing system.			
19	1	**MODULE V** **AIRCRAFT INSTRUMENTS:** Flight instruments and navigation instruments	Lecture/Lab Demonstration	BB/PPT	Pallet, E.H.J, "Aircraft Instruments & Principles", Pitman & Co 1993
20	3	Accelerometers, air speed indicators – mach meters – altimeters			
21	2	Gyroscopic instruments– principles and operation			
22	2	Engine instruments –			

		tachometers – temperature gauges – pressure gauge – operation and principles			
23	2	**MODULE VI** **MODERN AIRCRAFT SYSTEMS:** Auto pilot system - Digital fly by wire systems	Lecture/Lab Demonstration	BB/PPT	Pallet, E.H.J, "Aircraft Instruments & Principles", Pitman & Co 1993 .
24	1	Side stick intelligent flight control system active control Technology			
25	2	Electronic instrument display, EADI, EHSI			
26	2	communication and Instrument landing system:			

Date: 07-01-2019

Course faculty

Head of the Department