B.S. Abdur Rahman Crescent Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

LESSON PLAN

1. Course Title : Industrial Aerodynamics **5.Semester** : VI

2. Course Code : AEBX05 **6.Academic Year** : 2018 -19

3. Course Faculty : D.ROSHAN **7.Department** : Aerospace

4. Theory/Practical: Theory **8.No of Credits** : 3

Course Introduction:

This course offers an introduction to industrial aerodynamics and wind engineering with the main characteristics of natural winds. Characteristics of velocity profiles and atmospheric turbulence are described along with the effects of upstream exposure. Wind speed and turbulence models for inhomogeneous upstream exposures are presented in comparison with atmospheric measurements and wind-tunnel simulations. The basic elements of wind-building interaction in the time-averaged mode for uniform and boundary layer flows are described, external and internal pressures and forces on buildings with emphasis on design significance are discussed. Patterns of air pollutant dispersion influenced by natural winds are presented. Wind specifications in major international standards and codes together with wind loading provisions and urban air quality measures.

9. Course Learning Objectives:

To familiarize with non-aeronautical uses of aerodynamics such as road vehicle, building aerodynamics and problems of flow induced vibrations.

10. Course pre-requisites:

Fluid mechanics, Low speed Aerodynamics

11. Schedule of teaching and learning

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

[Refer Annexure]

12. Course materials and References

Handouts will be distributed / posted in website as and when required. References and a course content copy is given in Annexure.

13. **Assessment scheme**: Test 30 marks + Assignment 20 Marks

i) Periodical test

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

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

CAT I Module – I (Atmospheric Boundary Layer)
Module - II (Vehicle Aerodynamics)
Module - III (Wind Energy Collectors)

CAT II Module - IV (Building Aerodynamics)
Module - V (Flow induced Vibration)
Module - VI (Air pollutant Dispersion)

ii) Project Based Learning / Group Assignment

Type of assignment - Group (2 in a Group)

No. of assignments to be given - 2 (one from each assessment test portion)

Submission date - One week before the CAT examinations

Marks allotted - 40% marks for each assignment

14. Expected outcome of the course:

Students will be able to

- Understand the wind environment in the atmosphere and the structure of the atmospheric boundary layer
- Gain knowledge on applications of Aerodynamics in stability of road vehicles, Drag reduction techniques.
- Understand wind turbine physics, various types of wind turbines and design constraints
- To apply the knowledge of Aerodynamics to building designs and learn about building codes.
- Understand the practical problems involved flow induced vibrations and wind loads
- Understand air pollutant dispersion influenced by natural winds.

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	30-40	-	10-20
Course outcome 2			30-40	-	10-20
Course outcome 3			20-30	30-40	10-20
Course outcome 4			-	30-40	10-20
Course outcome 5			-	20-30	10-20
Course outcome 6			-	-	10-20

Date: 19/01/2019

Head of Department

D. Roshan 19/1/19
Course Faculty

ANNEXURE (vide item 11)
Schedule of Teaching and Learning

Module No	Topics to be covered	Duration in Periods	Teaching method BB/PP/Video
MODULE I	**ATMOSPHERIC BOUNDARY LAYER**	2	BB
	Atmospheric circulation,	1	BB
	Local winds, Terrain types, Mean velocity profiles,	1	BB
	Power law and logarithm law - wind speeds,	1	BB
	Turbulence profiles, Roughness parameters, simulation techniques in wind tunnels	2	
	Total Periods	7	
MODULE II	**VEHICLE AERODYNAMICS**	1	BB
	Boundary layers and separation,	2	BB
	Two dimensional wake and vortex formation- Strouhal and Reynolds numbers,	1	BB
	Separation and reattachments,	1	BB
	Power requirements and drag coefficients of automobiles,	2	BB
	Effects of cut back angle, aerodynamics of trains	1	
	Total Periods	8	
MODULE III	**WIND ENERGY COLLECTORS**	2	BB
	Horizontal and vertical axis machines,	2	BB
	energy density of different rotors,	2	BB
	Power Coefficient, Betz coefficient by momentum theory.	1	LCD
	Total Periods	7	
MODULE IV	**BUILDING AERODYNAMICS**	2	BB
	Pressure distribution on low rise buildings,	2	BB
	wind forces on buildings, Environmental winds in city blocks,	1	BB
	special problems of tall buildings,	1	
	building codes, ventilation and architectural aerodynamics	2	BB
	Total Periods	8	
MODULE V	**FLOW INDUCED VIBRATIONS**	1	BB
	Vortex shedding,	1	BB
	lock & effects of Reynolds number on wake formation in turbulent flows	2	
	wind galloping-wake galloping-along wind galloping of circular	2	BB

MODULE VI	cables-oscillation of tall structures and launch vehicles under wind loads-stall flutter.	2	BB
	Total Periods	8	
	AIR POLLUTANT DISPERSION	1	BB
	Effectiveness of dispersion, stack height and separation, air pollution control devices,	2	BB
	filters, leaning by pulse-jet, scrubbers- particulate scrubbers, gaseous pollutant scrubbers	2	BB
	absorbers, vapour emissions, dust suppression, open burning, trench burning, air pollution.	2	BB
	Total Periods	7	
	Total no. of hours	45	

AEBX05 **INDUSTRIAL AERODYNAMICS** **L T P C**
3 0 0 3

OBJECTIVE:

To familiarize with non-aeronautical uses of aerodynamics such as road vehicle, building aerodynamics and problems of flow induced vibrations.

MODULE I ATMOSPHERIC BOUNDARY LAYER 7

Atmospheric circulation, Local winds, Terrain types, Mean velocity profiles, Power law and logarithm law - wind speeds, Turbulence profiles, Roughness parameters, simulation techniques in wind tunnels

MODULE II VEHICLE AERODYNAMICS 8

Boundary layers and separation, Two dimensional wake and vortex formation-Strouhal and Reynolds numbers, Separation and reattachments, Power requirements and drag coefficients of automobiles, Effects of cut back angle, aerodynamics of trains.

MODULE III WIND ENERGY COLLECTORS 7

Horizontal and vertical axis machines, energy density of different rotors, Power Coefficient, Betz coefficient by momentum theory.

MODULE IV BUILDING AERODYNAMICS 8

Pressure distribution on low rise buildings, wind forces on buildings, Environmental winds in city blocks, special problems of tall buildings, building codes, ventilation and architectural aerodynamics

MODULE V FLOW INDUCED VIBRATIONS 8

Vortex shedding, lock & effects of Reynolds number on wake formation in turbulent flows across wind galloping-wake galloping-along wind galloping of circular cables-oscillation of tall structures and launch vehicles under wind loads-stall flutter.

MODULE VI AIR POLLUTANT DISPERSION 7

Effectiveness of dispersion, stack height and separation, air pollution control devices, filters, leaning by pulse-jet, scrubbers- particulate scrubbers, gaseous pollutant scrubbers, absorbers, vapour emissions, dust suppression, open burning, trench burning, air pollution.

TOTAL: 45

TEXT BOOK

1. Kroes Watkins Delp, Aircraft Maintenance and Repair, McGraw Hill, New York, 1993.

REFERENCES:

1. A&P Mechanics, Aircraft Hand Book, FAA Himalayan Book House, New Delhi, 1996
2. A&P Mechanics, General Hand Book, FAA Himalayan Bok House, New Delhi, 1996

Date: 19/01/2019

Head of Department
19/1/2019

19/1/19
Course Faculty

COURSE PLAN

1. **Course Title** : Behavior of Materials at High Temperatures **5. Semester:** VI
2. **Course Code** : AEBX12 **6. Academic Year** : 2018-19
3. **Course Faculty** : **Dr.P.N.Kadiresh** **7. Department** : Aero
4. **Theory / Practical** : Theory (Elective) **8. No. of Credits** : 3

9. **Course Learning Objectives:**

- To analyze the effect of high temperatures on the behavior of materials and material properties

10. **Course pre-requisites:**

- Engineering Chemistry
- Aircraft Materials

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**

- Power point material will be supplemented for all modules.
- A list of reference books is given along with lesson plan.

13. **Assessment Scheme:**

- Written Examination
  - Period Tests, CAT (40%)
  - Final Examination (50%)
- Continues Assessments
  - Assignments (10%)

i) **Periodical tests.**

Three numbers of period tests (CAT 1/2) of 90 minutes duration will be conducted. Maximum mark allotted is 50 Marks for each test.

ii) Term paper / Assignment

Group /individual assignment will be given for every two modules. There will be two numbers in total. Marks allotted are 10% for each assignment.

iii) Seminar

Topic: Use of Ni based and Co based super alloys in Modern Aircrafts.

iv) Carry Home Exercise

Case studies on different creep fracture on aircraft components exposed to high temperature environments.

v) Self Study

General mechanical properties of materials and their testing procedures.

vi) Content beyond Syllabus

A brief report about selection of suitable of materials used under high temperature environment (for different components of an aircraft).

14. Course outcomes

Students will be able to

1. Identify factors influencing functional life of components at elevated temperatures.
2. Evaluate fracture mechanism types and Interpret data from fracture maps of different alloys.
3. Apply laws of oxidation.
4. Depict hot gas corrosion methods and suggest methods to combat hot corrosion.
5. Gain knowledge of the role of super alloys in high temperature applications.
6. Comprehend ablative heat transfer phenomenon and suggest suitable ablative materials for space applications.

Date: 03.01.2019

Course faculty P.N. Kadwin

Head of the Department

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 Lesson Plan (Annexure)	CAT/End Sem Exam	100	-	40 - 45
Course outcomes 3, 4 & 5		CAT/End Sem Exam	-	100	40 - 45
Course outcome 6		End Sem Exam	-	-	10 - 20

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

Date: 03.01.2019

P. N. Kadhirvel

Course faculty

Head of the Department

ANNEXURE (vide item 11)
Schedule of Teaching and Learning

S.No.	Period	Topic	Mode of Delivery	Teaching Aids	Reference / Source
1	2	**MODULE I: CREEP** Factors influencing functional life of components at elevated temperatures.	Lecture	BB / PPT	1. Courtney T.H, Mechanical Behavior of Materials", McGraw-Hill, USA, 1990. 2. Bressers. J., "Creep and Fatigue in High Temperature Alloys", Applied Science, 1981.
2	1	Definition of creep curve, various stages of creep.			
3	1	Metallurgical factors influencing various stages.			
4	2	Effect of stress, temperature and strain rate.			
5	2	Design of transient creep time - Transient creep time - Ductile and brittle materials			
6	2	Hardening, strain hardening - Expressions of rupture life of creep.			
7	2	Monkman-Grant relationship			
8	1	**MODULE II: FRACTURE** Various types of fracture.	Lecture	BB/PPT	1. Hertzberg R. W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition, John Wiley, USA, 1996. 2. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals, USA, 1985
9	3	Brittle to ductile from low temperature to high temperature.			
10	3	Cleavage fracture, and ductile fracture due to micro void coalescence - diffusion controlled void growth.			
11	2	Fracture maps for different alloys and oxides.			
12	2	**MODULE III: OXIDATION AND HOT CORROSION:** Oxidation, Pilling, Bedworth ratio,	Lecture	BB/PPT	1. Courtney T.H, Mechanical Behavior of Materials", McGraw-Hill, USA, 1990. 2. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA, 1985.
13	1	kinetic laws of oxidation,			
14	2	Defect structure and control of oxidation by alloy additions.			

15	2	**MODULE IV: HOT CORROSION** Hot gas corrosion deposit, modified hot gas corrosion,	Lecture	BB/PPT	1. Courtney T.H, Mechanical Behavior of Materials", McGraw-Hill, USA, 1990. 2. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA, 1985.
16	2	Fluxing mechanisms, effect of alloying elements on hot corrosion,			
17	2	Interaction of hot corrosion and creep, methods to combat hot corrosion.			
18	2	**MODULE V: SUPER ALLOYS & ABLATION MATERIALS** Iron base, Nickel base and Cobalt base super alloys, composition control	Lecture	BB/PPT	1. Kenneth G.Budinski & Michael K. Budinski, "Engineering material properties and selection", Prentice Hall publications, 2010. 2. George F Titterton, Aircraft Materials and Processes, 5th Edition, Himalayan Books, 2010.
19	2	Solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase.			
20	2	Embrittlement, solidification of single crystals, Intermetallic.			
21	1	High temperature ceramics.			
22	2	**MODULE VI: ABLATION** Ablative materials - Applications	Lecture	BB/PPT	1. Kenneth G.Budinski & Michael K. Budinski, "Engineering material properties and selection", Prentice Hall publications, 2010. 2. George F Titterton, Aircraft Materials and Processes, 5th Edition, Himalayan Books, 2010.
23	1	Advantages and Disadvantages.			
24	2	Ablative heat transfer			

Date: 03.01.2019

P. N. Kadwin 03/1/19

Course faculty

Head of the Department

LESSON PLAN

1. Course Title : Theory of Elasticity
2. Course Code : AEB 3212
3. Course Faculty : S. V. Karthikeyan
4. Theory/Practical: Theory
5. Semester : VI
6. Academic Year: 2018-19
7. Department: Aerospace Engg.,
8. No. of Credits : 3

9. Course Learning Objectives:

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

10. Course pre-requisites:

Solid Mechanics, Aircraft Structural Mechanics and Aircraft Structural Analysis

11. Schedule of teaching and learning

As per Annexure-I

12. Course material and References

- Enrico Volterra & J.H. Caines, Advanced Strength of Materials, Prentice Hall, New Jersey, 1991.
- Wang, C.T., Applied Elasticity, McGraw–Hill Co., New York, 1993.
- Atkin, R. J., & Fox, N., An Introduction to the theory of Elasticity, Dover publication, 2005.
- Ansel C. Ugural and Fenter S. K., Advanced strength and applied elasticity, prentice hall, 2003.

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) Assignment

S.No	Topics	Marks
I	Module I, II&III	20
II	Module III, IV &V	20

iii)Quiz/ Comprehension

S.No	Topics	Marks
I	Module I, II&III	20
II	Module III, IV &V	20

14. Course Outcome: The student should be able to

- Determine the components of stress and strain tensors.
- Apply the conditions of compatibility and equations of equilibrium.
- Express the mechanical characteristics of materials, constitutive equations and generalized Hook law.
- Use the equilibrium equations stated by the displacements (Lame equations) and compatibility conditions stated by stresses (Beltrami-Michell equations).
- Determine the boundary restrictions in calculations.
- Solve the basic problems of the theory of elasticity by using Airy function expressed as bi-harmonic function.

4.1.19

15. Mapping of coarse outcomes with learning activities and assessments

Course outcomes	Learning activities	Assessments	CAT I* %	CAT II* %	End sem* %
Course outcome 1	Determine the components of stress and strain tensors.	Assessment test+ objective test + Assignments	25		15
Course outcome 2	Apply the conditions of compatibility and equations of equilibrium.		25		25
Course outcome 3	Express the mechanical characteristics of materials, constitutive equations andgeneralized Hook law.		10	20	15
Course outcome 4	Use the equilibrium equations stated by the displacements (Lame equations)and compatibility conditions stated by stresses (Beltrami-Michell equations).			25	15
Course outcome 5	Determine the boundary restrictions in calculations.			15	15
Course outcome 6	Solve the basic problems of the theory of elasticity by using Airy functionexpressed as biharmonic function.				15
Objective Test			20	20	
Assignment			20	20	

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

Date: 04-01-2019

Head of Department

Course Faculty

Annexure-I

UNIT No	Topics to be covered	Duration in Periods	Teaching method BB/PP/Video
MODULE I	ANALYSIS OF STRESS - Definitions, stress tensors, notations and sign conventions for stress	1	BB
	equations of equilibrium	2	BB/PPT
	principle stresses in three dimensions, Saint Venant's principle, problems	4	BB/PPT
MODULE II	ANALYSIS OF STRAIN - Strain – displacement relations, stress – strain relations	3	BB
	Lame's constant – cubical dilation, compressibility of material, bulk modulus, shear modulus	3	BB/PPT
	Compatibility equations for stresses and strains, problems.	1	BB
MODULE III	PLANE STRESS AND PLANE STRAIN PROBLEMS Airy's stress function	3	BB
	bi-harmonic equations, polynomial solutions	3	BB
	simple two-dimensional problems in cartesian coordinates like bending of cantilever and simply supported beams, etc.	3	BB
MODULE IV	POLAR COORDINATES - Equations of equilibrium, strain displacement relations, stress-strain relations	4	BB
	problems axi-symmetric Equilibrium and strain displacement relations	3	BB
MODULE V	STRESS CONCENTRATION - Stress due to concentrated load	3	BB
	stress distribution near concentrated load acting on beam	2	BB
	Kirsch and Boussinesque problems	2	BB/PPT
MODULE VI	TORSION Navier's theory, St. Venant's theory, Prandtl's theory on torsion	3	BB
	The semi- inverse method and applications to shafts of circular,	2	BB
	Elliptical, equilateral triangular and rectangular sections.	3	BB
	TOTAL PERIODS	45Hours	

COURSE PLAN

1. **Course Title** : Flight Dynamics
2. **Course Code** : AEB 3211
3. **Course Faculty** : **S.Karthikeyan**
4. **Theory / Practical** : Theory
5. **Semester** : VI
6. **Academic Year** : 2018-19
7. **Department** : Aero
8. **No. of Credits** : 3

9. **Course Learning Objectives:**

- To introduce the study of performance and stability characteristics of aircraft under various operating conditions and atmospheric disturbances.

10. **Course pre-requisites:**

NA

11. **Schedule of Teaching and Learning**

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

[Furnished as Annexure]

Teaching delivery mode involved:

Traditional	ICT	Experimental	Simulated	Participating (Seminar)	Any other
40	20	-	-	30	10

12. **Course Material and References**

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

21/1/2019

13. Assessment Scheme:

Scheme of assessment	Assessment 1			Assessment 2			End Semester Exam
	CAT 1	Assignment	Seminar	CAT 2	Assignment	Seminar	
Marks in percentage	60	20	20	60	20	20	100
Internal & End semester Marks	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

NA

iii) Seminar

Topic: Collection of course related parameter (Range, Endurance etc.) for various working airplanes.

iv) Carry Home Exercise

Case study may be given.

v) Self Study

- Why airplanes having different wing?

vi) Content beyond Syllabus

- Simple exercise / project may be given for understanding of working of control surfaces.

14. Course outcomes

21/1/2019

OUTCOMES:

Students will be able to

- Calculate the performance parameters of the aircraft during steady level flight, climb, cruise, descent, take off and landing.
- Obtain drag polar of the aircraft.
- Construct the V-n diagram for aircraft.
- Calculate the basic design parameters such as range and endurance.
- Gain knowledge of static stability of the aircraft.
- Acquire knowledge of dynamic stability of the aircraft
-

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	3	Over view of **Mod 1** Forces and moments acting on a flight vehicle , equation of motion of a rigid flightvehicle,differenttypesofdrag	Lecture + ICT	Black Board& PPT	Anderson,J.D.,"Aircraftperformanceanddesign",McGrawHill,1995.
2	2	Drag polar of vehicles from low speed to high speeds			
3	2	Variation of thrust, power and sfc with velocity and altitudes for air breathing engines and rockets, power available and power required curves. **(Total 7 periods)**			
4	1	Over view of **Mod 2** Performanceofairplaneinlevelflight,maximumspeedinlevelflight,conditions forminimum drag and power required	Lecture+ ICT+ Group Discussion	Black Board & PPT	Anderson,J.D.,"Aircraftperformanceanddesign",McGrawHill,1995.
5	1	Range and endurance, climbing and gliding flight-maximum rate of climb and steepest angle of climb			
6	2	Minimum rateofsinkandshallowestangleofglide			
7	2	Turningperformance-Turningrate turn radius, Bank angle. Limitations of pull up and push over			
8	2	V-n diagram andloadfactor. **(Total 8 Periods)**			
9	2	Over view of **Mod 3** Degree of freedom of rigid bodies in space, Static and dynamic stability	Lecture + ICT	Black Board & PPT	Anderson,J.D.,"Aircraftperformanceanddesign",McGrawHill,1995.
10	1	Static longitudinal stability. stick fixed stability. basic equilibrium equation			
11	2	Stability criterion. effects of fuselage and nacelle			
12	1	Influence of CG location. power effects, stick fixed neutral point, stick free stability			
13	1	Hinge moment coefficient, stick free neutral points, symmetric maneuvers,			
14	1	Stick force gradients,aerodynamicbalancing. **(Total 8 periods)**			
15	1	Over view of **Mod 4** Staticdirectionalstability	Lecture+	Black	Perkins,C.D.,andHage,R.E.,"Airplane PerformancestabilityandControl",

16	1	Rudderfixed–directionalcontrol,Stickfreedirectional stability	ICT	Board & PPT	JohnWiley&Son,Inc,NewYork,2011.
17	1	Adverse yaw effects –slip stream rotation			
18	2	Crosswind during takeoff andlanding,			
19	2	Spinning,Antisymmetricpower **(Total 7 Periods)**			
20	1	Over view of **Mod 5** Dihedraleffect–estimationofairplanedihedraleffect	Lecture + group Discussion	Black Board & PPT	Perkins,C.D.,andHage,R.E.,"Airplane PerformancestabilityandControl", JohnWiley&Son,Inc,NewYork,2011.
21	1	Effectsofwingsweeps, flaps,powerondihedraleffect,			
22	2	Lateralcontrol			
23	2	Aileroncontrolforces,aileron levers. **(Total 6 Periods)**			
24	1	Over view of **Mod 6** Equation of longitudinal motion Evaluation of stability derivatives	Lecture+ Group discussion	Black Board & PPT	Perkins,C.D.,andHage,R.E.,"Airplane PerformancestabilityandControl", JohnWiley&Son,Inc,NewYork,2011.
25	2	Solution of equation of motion(stick fixed case), solution of equation of motion (stick free case)			
26	1	Lateral dynamics – lateral degrees of freedom, characteristics motion ofthe airplane with control locked			
27	2	Evaluation ofstability derivatives,			
28	3	Response to aileron control, response to aileron with adverse yaw, dynamiclateral stability rudder free, aileron free. **(Total 9 Periods).**			

Total 45 periods

Date: 07.01.19

Course faculty

Head of the Department

21/1/2019

COURSE PLAN

1. **Course Title** : **Rockets and Missiles**
2. **Course Code** : **AEBX17**
3. **Course Faculty** : **Mr. Sri Nithya Mahottamananda**
4. **Theory / Practical** : **Theory**
5. **Semester** : **VI**
6. **Academic Year** : **2018-19**
7. **Department** : **Aerospace Engineering**
8. **No. of Credits** : **3**

9. **Course Learning Objectives:**

- To introduce the principles of design, development, operation and flight of rockets and missiles.

10. **Course pre-requisites:**

- Knowledge in basics of propulsion, Aerodynamics and flight dynamics.

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. Cornelisse, J.W., Schoyer H.F.R., Wakker K.F., "Rocket Propulsion and Space Dynamics", Pitman Publishing, 1979.
2. Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons, 2000.
3. Chin, S.S., "Missile configuration Design", McGraw-Hill, 1961.
4. Parker, E.R., "Material for Missiles and Spacecraft", McGraw Hill Book Co.Inc., 1982.

References

1. Barrere et al, "Rocket propulsion", Elsevier publisher Co., 1960.
2. Martin J. L. Turner, "Rocket and Spacecraft propulsion: Principles, Practice & New Developments", Springer Praxis, 2004.
3. N. Nielsen, "Missile Aerodynamics", Mountain View, Near, Inc., 1998.

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%
Objective type Test	20%	20%	-----
Assignment	20%	20%	------

CAT I — Module I (SOLID ROCKET SYSTEMS)
Module -II (LIQUID ROCKET SYSTEMS)
Module III (AERODYNAMICS OF ROCKETS AND MISSILES)

CAT II — Module IV (ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD)
Module V (STAGING AND CONTROL OF ROCKETS AND MISSILES)
Module VI (MATERIALS FOR ROCKET AND MISSILE APPLICATIONS)

ii) Term paper / Assignment

Type of assignment	-	Individual
No. of assignments to be given	-	2 (one from each assessment test portion)
Submission date	-	One week from the date of giving assignment
Marks allotted	-	20% marks for each assignment

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 I : Rockets - purpose

Module VI : various adverse conditions faced by aerospace vehicles and the requirement of Materials to perform under these conditions.

14. **Course outcomes**

Student will be able to

- Classify and identify the various parts of a solid rocket and the geometry & chemical combinations of the propellants.
- Acquire knowledge of the ignition and feed systems of the liquid rocket and their design parameters.
- Apply the law of aerodynamics on the flight performance of the rockets and missiles and do the classification of various types of missiles.
- Solve the rocket performance related problems and find the range and altitude gained in the ideal conditions.
- Recognize various types of multi-staging in the rockets and distinguish their separation techniques. They will also be able to explain the thrust vectoring control methods including secondary injection thrust vector control method.
- Differentiate the various materials used in the rockets and missiles.

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, objective test and Assignments	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 SOLID ROCKET SYSTEMS					
1	1	Introduction - Rockets - purpose - classifications	Lecture /ICT/ Assignment	Black board & PPT	T_2
2	1	components - functions, Solid-fuel rockets		Black board & PPT	T_2
3	1	basic concepts, design, solid propellants,		Black board & PPT	T_2
4	1	Grain geometry,		Black board & PPT	T_2
5	1	Casing		Black board & PPT	T_2
6	1	Nozzle, Performance.		Black board & PPT	T_2
MODULE II LIQUID ROCKET SYSTEMS					
7	2	Ignition system in rockets	Lecture /ICT/ Project	Black board & PPT	T_2
8	2	types of igniters and igniter design considerations		Black board & PPT	T_2
9	2	injection system and propellant feed systems of liquid rockets and their design considerations		Black board & PPT	T_2
10	1	design considerations of liquid rocket thrust chambers		Black board & PPT	T_2
11	1	Combustion mechanisms.		Black board & PPT	T_2
MODULE III AERODYNAMICS OF ROCKETS AND MISSILES					
12	1	Airframe components of rockets and missiles	Lecture /ICT	Black board & PPT	T_1 & T_3
13	1	forces acting on a missile while passing through atmosphere		Black board & PPT	T_1 & T_3

14	1	classification of missiles - slender body aerodynamics		Black board & PPT	T_1 & T_3
15	2	method of describing forces and moments - lift force and lateral moment		Black board & PPT	T_1 & T_3
16	2	-lateral aerodynamic damping moment - longitudinal moment		Black board & PPT	T_1 & T_3
17	2	Body upwash and body downwash in missiles - rocket dispersion.		Black board & PPT	T_1 & T_3
MODULE IV ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD					
18	2	One dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields	Lecture /ICT	Black board & PPT	T_1
19	2	description of vertical, inclined and gravity turn trajectories		Black board & PPT	T_1
20	1	determination of range and altitude		Black board & PPT	T_1
21	1	simple approximations to burn out velocity and altitude		Black board & PPT	T_1
22	2	Estimation of culmination time and altitude.		Black board & PPT	T_1
MODULE V STAGING AND CONTROL OF ROCKETS AND MISSILES					
23	1	Design philosophy behind multistaging of launch vehicles and ballistic missiles	Lecture/ Assignment	Black board & PPT	T_2 & R_1
24	1	multistage vehicle optimization		Black board & PPT	T_2 & R_1
25	1	stage separation techniques in atmosphere and in space		Black board & PPT	T_2 & R_1
26	1	stage separation dynamics and lateral separation characteristics		Black board & PPT	T_2 & R_1
27	2	various types of thrust vector control methods including secondary injection thrust vector control		Black board & PPT	T_2 & R_1
28	2	Numerical problems on stage separation and multistaging.		Black board & PPT	T_2 & R_1

MODULE VI MATERIALS FOR ROCKET AND MISSILE APPLICATIONS					
29	1	Selection criteria of materials for rockets and missiles	Lecture/ Assignment	Black board & PPT	T_4
30	2	materials for various airframe components and engine parts		Black board & PPT	T_4
31	1	materials for thrust control devices		Black board & PPT	T_4
32	2	Various adverse conditions faced by aerospace vehicles and the requirement of materials to perform under these conditions.		Black board & PPT	T_4

B.S. Abdur Rahman Crescent Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

COURSE PLAN

1. Course Title : Basic Electronics and control systems
2. Course Code : EIB3281
3. Course Faculty : Mr.M.Magesh
4. Theory / Practical : Theory
5. Semester :VI
6. Academic Year :2018-19
7. Department :Aerospace
8. No. of Credits :3

9. Course Learning Objectives:

- To acquaint the students to semiconductor devices and their applications
- To introduce the basic methods of designing the digital circuits and provide the fundamental concepts used in the design of digital systems
- To introduce some knowledge about the microprocessor and its programming
- To introduce the basic knowledge of flight control system and flight Deck

10. Course pre-requisites:

- Basic Electronics.

11. Schedule of teaching and learning

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

[To be furnished as Annexure]

Traditional	ICT	Experimental	Simulated	Participating	Any other
30	30	20	-	10	10

12. Course material and References

1. V.K. Mehta, "Principles of Electronics", 2nd Edition, S. Chand & Co., New Delhi, 2002.
2. Goankar R.S, "Microprocessors, Programming to Architecture 8085", 5th Edition, Penram International publishing Pvt. Ltd., New Delhi, 2002.
3. Ogata, Modern Control Engineering, Prentice Hall of India Pvt. Ltd., New Delhi, 1998.
4. M.M. Mano, "Digital Design", 3rd Edition, Prentice Hall of India.
5. Nagrath & Gopal, "Control System Engineering", 3rd Edition, New Age International Edition, 2002.

13. **Assessment Scheme:**

(i) Continuous Assessment Test (CAT) – 2

- Each CAT carries a maximum of 30 marks

(ii) Progress of the project is assessed for a maximum of 20 marks for each CAT.

14. **Course outcomes**

Students will be able to

- Demonstrate the ability to design a system using various semiconductor devices.
- Keep abreast of the latest digital technology and design of various digital logic circuits.
- Demonstrate the fundamental understanding of the operation of the microprocessor and its interfacing devices and apply the programming techniques
- Describe the response characteristics and differentiate between the open loop and closed loop of a control system.

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, Project based Learning, End sem.	70%		40-45%
Course outcome 3 & 4	Continuous Assessment test, Project based Learning, End sem	30%	70%	40-45%
Course outcome 5 & 6	Continuous Assessment test, Project based Learning, End sem		30%	10-20%

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

Date: 07-01-19

Mukesh.M 07/01/19.

Course faculty

Head of the Department

7/1/19

ANNEXURE (vide item 11)
Schedule of Teaching and Learning

S.No.	Period	Topic	Mode of Delivery	Teaching Aids	Reference / Source
1	1	**MODULE I SEMI CONDUCTOR DEVICES** Introduction to Semi conductor – PN Junction diode	Lecture/Lab Demonstration	BB/PPT	V.K. Mehta, "Principles of Electronics", 2nd Edition, S. Chand & Co., New Delhi, 2002
2	1	Zener Diode – Tunnel Diode			
3	2	Transistor – FET and MOSFET			
4	1	Silicon Controlled Rectifier, Diac and Triac			
5	1	Half wave and full wave Rectifier			
6	1	Filter – Ripple Factor – Regulators			
7	1	Principle and Types of Transistor Amplifiers.			
8	1	**MODULE II LINEAR AND DIGITAL ICS :** Number representation – Binary, Octal and Hexadecimal Number System	Lecture/ Assignment	BB/PPT	V.K. Mehta, "Principles of Electronics", 2nd Edition, S. Chand & Co., New Delhi, 2002 M.M. Mano, "Digital Design", 3rd Edition, Prentice Hall of India.
9	1	Logic families and Logic Gates.			
10	1	Half and full Adder			
11	1	Multiplexers – Demultiplexers – Decoders – Encoders			
12	1	Flip-flops – Registers - Counters			
13	1	Fabrication of Linear and Digital IC's			
14	1	D/A and A/D converters			
15	1	Comparison between Analog and Digital systems			
11	2	**MODULE III 8085 MICROPROESSOR :** Introduction to Microprocessor	Lecture/Lab Demonstration	BB/PPT	Goankar R.S, "Microprocessors,

12	3	Block diagram of 8085 Microprocessor .			Programming Architecture 8085", 5th Edition, Penram International publishing Pvt. Ltd., New Delhi, 2002.
13	3	Architecture of Intel 8085 – Microprocessor.			
16	1	**MODULE IV INSTRUCTION SET FOR 8085:** Addressing modes of 8085	Lecture/ Assignment/ Lab Demonstration	BB/PPT	Goankar R.S, "Microprocessors, Programming to Architecture 8085", 5th Edition, Penram International publishing Pvt. Ltd., New Delhi, 2002.
17	2	Instruction set classification			
18	2	Arithmetic instruction logical instruction –data transfer instruction-branch instruction-PUSH, POP , call and jump instruction			
19	2	Simple programs using 8085.			
20	1	**MODULE V SYSTEM AND THEIR REPRESENTATION:** Basic elements of control system	Lecture/ project/ MATLAB Programming	BB/PPT	Nagrath & Gopal, "Control System Engineering", 3rd Edition, New Age International Edition, 2002.
21	1	Open and closed loop system – transfer function- transfer function			
22	2	Block diagram reduction			
23	1	Mathematical model of Physical systems: Thermal system, Pneumatic system,			
24	1	Hydraulic system, Flight Control system			
25	1	**MODULE VI TIME REPSONSE AND FREQUENCY RESPONSE:** Time response-test signals –	Lecture/ project/ MATLAB Programming	BB/PPT	

		response of first and second order systems for unit step input			Nagrath & Gopal, "Control System Engineering", 3rd Edition, New Age International Edition, 2002.
26	2	Time domain Specification			
27	2	Frequency response: Bode plot - Specification:			
28	1	Gain margin and Phase margin.			

Date: 07-01-2019

Mukesh. M 07/01/19.

Course faculty

Head of the Department 07/1/2019