INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

AERONAUTICAL ENGINEERING
COURSE DESCRIPTION

Course Title	**AEROSPACE STRUCTURAL DYNAMICS LABORATORY**				
Course Code	AAEC45				
Program	B.Tech				
Semester	VII				
Course Type	Laboratory				
Regulation	UG-20				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	-	-	-	3	1.5
Course Coordinator	Mr G Shiva krishna, Assistant Professor				

I COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
B.Tech	AMEC24	II	Aircraft Stability and Control

II COURSE OVERVIEW:

This course focuses on mechanical devices that are designed to have mobility to perform certain functions. In this process they are subjected to some forces. This course will provide the knowledge on how to analyze the motions of mechanisms and design mechanisms to give required strength. This includes relative static and dynamic force analysis and consideration of gyroscopic effects on aero planes, ships, automobiles like two wheelers and four wheelers. Balancing of rotating and reciprocating masses, friction effect in brakes clutches and dynamometers are also studied. Mechanical vibrations give an insight into the various disturbances while designing vibratory systems.

III MARKS DISTRIBUTION:

Subject	SEE Examination	CIE Examination	Total Marks
AEROSPACE STRUCTURAL DYNAMICS LABORATORY	70 Marks	30 Marks	100

IV DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✓	Demo Video	✓	Lab Worksheets	✓	Viva Questions	✓	Probing further Questions

V EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks forinternal assessment and 70 marks for semester end lab examination. Out of 30 marks ofinternal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end labexamination for 70 marks shall be conducted by two examiners, one of them beingInternal Examiner and the other being External Examiner, both nominated by thePrincipal from the panel of experts recommended by Chairman, BOS. The emphasis on the experiments is broadly based on the following criteria given in Table: 1

	Experiment Based	Programming based
20 %	Objective	Purpose
20 %	Analysis	Algorithm
20 %	Design	Programme
20 %	Conclusion	Conclusion
20 %	Viva	Viva

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Component	**Laboratory**		**Total Marks**
Type of Assessment	**Day to day performance**	**Final internal lab assessment**	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

1. **Experiment Based**

Objective	Analysis	Design	Conclusion	Viva	Total
2	2	2	2	2	10

2. **Programming Based**

Objective	Analysis	Design	Conclusion	Viva	Total
-	-	-	-	-	0

VI COURSE OBJECTIVES:

The students will try to learn:

I	The basic principles of kinematics and there lated terminology of machines.
II	The Discriminate mobility; enumerate links and joints in the mechanisms.
III	The concept of analysis and formulation of different mechanisms.

VII COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Choose** the function of governors and gyroscopes in aerospace systems.	Understand
CO 2	**Perform** static and dynamic force analysis of mechanisms. the complex surfaces	Apply
CO 3	**Calculate** the balancing forces and reciprocating masses in mechanical systems.	Apply
CO 4	**Analyze** longitudinal and lateral vibrations in mechanical systems.	Apply
CO 5	**Design and evaluate** the critical speed of rotating shafts and mechanisms.	Apply
CO 6	**Investigate** free and forced vibrations in beam structures, particularly cantilever beams	Apply

VIII PROGRAM OUTCOMES:

Program Outcomes	
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design/Development of Solutions:** Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Program Outcomes	
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-Long Learning:** Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

IX HOW PROGRAM OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PO1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	CIA,SEE
PO3	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety,	3	CIA,SEE
PO4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	CIA,SEE
PO12	Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	CIA,SEE

3 = High; 2 = Medium; 1 = Low

X HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program		Strength	Proficiency Assessed by
PSO 3	Make use of multi physics, computational fluid dynamics and flight simulation tools for building career paths towards innovative startups, employability and higher studies.	1	CIA,SEE

3 = High; 2 = Medium; 1 = Low

XI MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

COURSE OUTCOMES	PROGRAM OUTCOMES				PSO'S
	PO 1	PO 3	PO 4	PO12	PSO 3
CO 1	✓				

CO 2		✓	✓		
CO 3	✓		✓		
CO 4		✓		✓	
CO 5	✓				✓
CO 6		✓		✓	

XII ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certification	-

XIII ASSESSMENT METHODOLOGY INDIRECT:

✓	Early Semester Feedback	✓	End Semester OBE Feedback
X	Assessment of Mini Projects by Experts		

XIV SYLLABUS:

WEEK I	**Week-1: GOVERNORS**
	To study the function of a Governor.
WEEK II	**Week-2: GYROSCOPE**
	To determine the Gyroscope couple.
WEEK III	**Week-3: STATIC FORCE ANALYSIS**
	To draw free body diagram and determine forces under static condition.
WEEK IV	**Week-4: DYNAMIC FORCE ANALYSIS**
	To draw free body diagram and determine forces under dynamic condition
WEEK V	**Week-5: BALANCING**
	To determine balancing forces and reciprocating masses.
WEEK VI	**Week-6: BEARINGS**
	To determine the bearing life.
WEEK VII	**Week-7: LONGITUDINAL AND LATERAL VIBRATIONS**
	To determine the longitudinal and transfer vibration
WEEK VIII	**Week-8: VIBRATION ANALYSIS OF SHAFT**
	To determine critical speed of a shaft.
WEEK IX	**Week-09: MECHANISMS**
	To design various mechanism and their inversions
WEEK X	**Week-10: DIFFERENTIAL GEAR BOX**
	To study automobile differential gear box
WEEK XI	**Week-11: FREE VIBRATION OF CANTIEVER BEAM**
	T.To study Vibrations in beam Structures
WEEK XII	**Week-12: FORCED VIBRATION OF CANTIEVER BEAM**
	To study Vibrations in beam Structures

TEXTBOOKS

1. Joseph E. Shigley, "Theory of Machines and Mechanisms", Oxford University Press, 4th Edition, 2010.

2. Thomas Bevan, "Theory of Machines", Pearson, 3rd Edition, 2009.

REFERENCE BOOKS:

1. http://www.e-booksdirectory.com.

XV COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	GOVERNORS	Co1	book1
2	GYROSCOPE	Co1	book1
3	STATIC FORCE ANALYSIS	Co2	book1
4	DYNAMIC FORCE ANALYSIS	Co2	book1
5	BALANCING	Co3	book1
6	BEARINGS	Co3	book1
7	LONGITUDINAL AND LATERAL VIBRATIONS	Co3	book1
8	VIBRATION ANALYSIS OF SHAFT	Co4	book1
9	MECHANISMS	Co4	book2
10	DIFFERENTIAL GEAR BOX	Co5	book2
11	FREE VIBRATION OF CANTIEVER BEAM	Co5	book2
12	FORCED VIBRATION OF CANTIEVER BEAM	Co1	book2

XVI EXPERIMENTS FOR ENHANCED LEARNING (EEL):

S.No	Design Oriented Experiments
1	Design of a Gyroscopic Stabilizer
2	Analysis of Vibration Isolation in Aircraft Components
3	Dynamic Force Analysis of Landing Gear Mechanism
4	Optimization of Balancing Techniques in Rotating Turbine Blades
5	Advanced Vibration Analysis of Multi-Mass Systems

Signature of Course Coordinator **HOD,AE**
Mr G Shiva krishna.