INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

AEROSPACE ENGINEERING

COURSE DESCRIPTOR

Course Title	**ADVANCED MATHEMATICS IN AEROSPACE ENGINEERING**				
Course Code	**BAEB01**				
Programme	**M. Tech**				
Semester	**I**	**AE**			
Course Type	**Core**				
Regulation	**IARE - R18**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Practicals**	**Credits**
	3	**-**	**3**	**-**	**-**
Chief Coordinator	**Ms. P Srilatha, Assistant Professor**				
Course Faculty	**Ms. P Srilatha, Assistant Professor**				

I. COURSE OVERVIEW:

The course focuses on more advanced Engineering Mathematics topics which provide with the relevant mathematical tools required in the analysis of problems in engineering and scientific professions. The course includes probability theory, discrete and continuous random variables, probability distributions, sampling distribution, testing of hypothesis, ordinary differential equations and partial differential equations. The mathematical skills derived from this course form a necessary base to analytical and design concepts encountered in the program.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
-	-	-	Basic principles of Statistics and Algebra	-

III. MARKS DISTRIBUTION

Subject	SEE Examination	CIA Examination	Total Marks
Advanced Mathematics in Aerospace Engineering	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	LCD / PPT	✔	Seminars	✔	Videos	✘	MOOCs
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each Unit carries equal weight age in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each Unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
30 %	To test the analytical skill of the concept.
20 %	To test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Technical Seminar and Term Paper.

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	**CIE Exam**	**Technical Seminar and Term Paper**	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 9th and 17th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration, consisting of 5 one mark compulsory questions in part-A and 4 questions in part-B. The student has to answer any 4 questions out of five questions, each carrying 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Technical Seminar and Term Paper:

Two seminar presentations and the term paper with overview of topic are conducted during II semester. The evaluation of Technical seminar and term paper is for maximum of 5 marks. Marks are awarded by taking average of marks scored in two Seminar Evaluations.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	Identify, formulate, and solve complex aerospace engineering problems by applying advanced principles of engineering.	3	Presentation on real-world problems
PO 2	Apply aerospace engineering design to produce solutions that meet specified needs with frontier technologies.	2	Seminar
PO 3	Formulate and solve complex engineering problems related to aerospace materials, propulsion, aerodynamics, structures, avionics, stability and control.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES:

The course should enable the students to:

I	Develop a basic understanding of a range of mathematics tools with emphasis on engineering applications.
II	Solve problems with techniques from advanced linear algebra, ordinary differential equations and multivariable differentiation.
III	Develop skills to think quantitatively and analyze problems critically.

VIII. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Describe the basic concepts of probability, discrete, continuous random variables and determine probability distribution, sampling distribution of statistics like t, F and chi-square.	CLO 1	Describe the basic concepts of probability, discrete and continuous random variables
		CLO 2	Determine the probability distribution to find mean and variance.
		CLO 3	Discuss the concept of sampling distribution of statistics like t, F and chi-square.
CO 2	Understand the foundation for hypothesis testing to predict the significance difference in the sample means and the use of ANOVA technique.	CLO 4	Understand the foundation for hypothesis testing.
		CLO 5	Apply testing of hypothesis to predict the significance difference in the sample means.
		CLO 6	Understand the assumptions involved in the use of ANOVA technique.
CO 3	Determine Ordinary linear differential equations solvable by nonlinear ODE's.	CLO 7	Solve differential equation using single step method.
		CLO 8	Solve differential equation using multi step methods.
		CLO 9	Understand the concept of non- linear ordinary differential equations.
CO 4	Explore First and second order partial differential equations.	CLO 10	Understand partial differential equation for solving linear equations.

		CLO 11	Solving the first order ordinary differential equations subject to boundary conditions.
		CLO 12	Solving the higher order ordinary differential equations subject to boundary conditions.
CO 5	Analyze the methods for partial differential equations.	CLO 13	Understand the concept of methods for elliptic partial differential equations.
		CLO 14	Understand the concept of Neumann and mixed problems.
		CLO 15	Analyze the concept of parabolic and hyperbolic partial differential equations.

IX. COURSE LEARNING OUTCOMES(CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to	PO's Mapped	Strength of Mapping
BAEB01.01	CLO 1	Describe the basic concepts of probability, discrete and continuous random variables	PO 2	2
BAEB01.02	CLO 2	Determine the probability distribution to find mean and variance.	PO 1, PO 2	3
BAEB01.03	CLO 3	Discuss the concept of sampling distribution of statistics like t, F and chi-square.	PO 1, PO 2	3
BAEB01.04	CLO 4	Understand the foundation for hypothesis testing.	PO 2	2
BAEB01.05	CLO 5	Apply testing of hypothesis to predict the significance difference in the sample means.	PO 1	3
BAEB01.06	CLO 6	Understand the assumptions involved in the use of ANOVA technique.	PO 3	1
BAEB01.07	CLO 7	Solve differential equation using single step method.	PO 2	2
BAEB01.08	CLO 8	Solve differential equation using multi step methods.	PO 2	2
BAEB01.09	CLO 9	Understand the concept of non- linear ordinary differential equations.	PO 1, PO 2	3
BAEB01.10	CLO 10	Understand partial differential equation for solving linear equations.	PO 1, PO 2	3
BAEB01.11	CLO 11	Solving the first order ordinary differential equations subject to boundary conditions.	PO 1, PO 3	2
BAEB01.12	CLO 12	Solving the higher order ordinary differential equations subject to boundary conditions.	PO 2	2
BAEB01.13	CLO 13	Understand the concept of methods for elliptic partial differential equations.	PO 1	3
BAEB01.14	CLO 14	Understand the concept of Neumann and mixed problems.	PO 1	3
BAEB01.15	CLO 15	Analyze the concept of parabolic and hyperbolic partial differential equations.	PO 3	1

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (POs)		
	PO 1	PO 2	PO 3
CO 1	3	2	1
CO 2		2	1
CO 3	3	2	
CO 4	3	2	
CO 5		2	1

XI. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Learning Outcomes (CLOs)	Program Outcome (PO)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CLO 1		2										
CLO 2	3	2										
CLO 3	3	2										
CLO 4		2	1									
CLO 5	3											
CLO 6			1									
CLO 7		2										
CLO 8		2										
CLO 9	3	2										
CLO 10	3	2										
CLO 11	3		1									
CLO 12		2										
CLO 13	3											
CLO 14	3											
CLO 15			1									

3 = High; 2 = Medium; 1 = Low

XII. ASSESSMENT METHODOLOGIES –DIRECT

CIE Exams	PO1, PO2, PO3	SEE Exams	PO1, PO2, PO3	Seminar and Term Paper	PO1, PO2, PO3
Viva	-	Mini Project	-	Laboratory Practices	-

XIII. ASSESSMENT METHODOLOGIES -INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIV. SYLLABUS:

UNIT-I	**PROBABILITY THEORY AND DISTRIBUTIONS**
Theory Probability Theory and Sampling Distributions. Basic probability theory along with examples. Standard discrete and continuous distributions like Binomial, Poisson, Normal, Exponential etc. Central Limit Theorem and its significance. Some sampling distributions like chi-square, t, F distributions.	
UNIT-II	**TESTING OF STATISTICAL HYPOTHESIS**
Testing a statistical hypothesis, tests on single sample and two samples concerning means and variances. ANOVA: One – way, Two – way with/without interactions.	
UNIT-III	**ORDINARY DIFFERENTIAL EQUATIONS**
Ordinary linear differential equations solvable by direct solution methods. Non-linear differential equations solvable by direct solution methods.	
UNIT-IV	**PARTIAL DIFFERENTIAL EQUATIONS AND CONCEPTS IN SOLUTION TO BOUNDARY VALUE PROBLEMS**
First and second order partial differential equations; canonical forms	
UNIT-V	**NUMERIC'S FOR ORDINARY DIFFERENTIAL EQUATIONS AND PARTIAL DIFFERENTIAL EQUATIONS**
Methods for first order ordinary differential equations, multistep methods, methods for systems and higher order ordinary differential equations, methods for elliptic partial differential equations, Neumann and mixed problems, irregular boundary, methods for parabolic and hyperbolic partial differential equations.	
Text Books:	
1. J. B. Doshi, "Differential Equations for Scientists and Engineers", Narosa, New Delhi. 2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, Delhi.	
Reference Books:	
1. S. P. Gupta, "Statistical Methods", S. Chand & Sons, 37th revised edition. 2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India (9th Edition)".	

XV. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Define the concept of probability.	CLO 1	T2:26.1 R2:22.3
2-4	Describe the concept of Random variables, Contrast discrete Random variables and also calculate the mean and variance of discrete Random variables, probability distribution	CLO 1	T2:26.7 R2:22.5
5-6	Recall characteristics of the Binomial Distribution and find mean , variance	CLO 2	T2:26.14 R2:22.7
7-8	Recognize cases where Poisson Distribution could be appropriate model to find mean and variance	CLO 2	T2:26.15 R2:22.7
9-11	Apply Normal Distributions find the probability over a set of values, mean and variance	CLO 2	T2:26.16 R2:22.8
11-12	Recall the definition of a t-statistics in terms of statistics of sample from a normal distribution	CLO 3	T2:27.14 R2:23.1
13	Apply the definition of F-distribution	CLO 3	T2:27.19 R2:23.4
14-15	Apply the definition of χ^2 –Distribution	CLO 3	T2:27.17 R2:23.7
16	Apply χ^2 - distribution of goodness of fit	CLO 3	T2:27.18 R2:23.7
17-18	Understand the foundation for classical inference involving hypothesis testing and two types of errors possible.	CLO 4	T2:27.12 R2:23.4
19	Explain level of significance and confidence interval.	CLO 4	T2:27.11 R2:23.3
20-22	Determine the testing of hypothesis for single and difference of means.	CLO 5	T2:27.12 R2:23.4
23-24	Understand the assumptions involved in the use of ANOVA one-way classification technique.	CLO 6	T2:27.20
25-26	Understand the assumptions involved in the use of ANOVA two-way classification technique.	CLO 6	T2:27.20
27	Solve differential equation using Taylor series method	CLO 7	T2:32.3 R2:19.1
28-30	Solve differential equation using Eulers method, Euler's modified method and Runge kutta method.	CLO 8	T2:32.6 R2:19.2
31-32	Understand the concept of non- linear ordinary differential equations.	CLO 9	T2:32.8 R2:19.3
33-34	Understand partial differential equation for solving linear equations.	CLO 10	T2:17.2 R2:11.1
35-36	Solving the one-dimensional heat equation in subject to boundary conditions.	CLO 11	T2:18.5 R2:11.5
37-38	Solving the one-dimensional wave equation in subject to boundary conditions.	CLO 12	T2:18.4 R2:11.4
39	Apply canonical forms for boundary value problems.	CLO 12	T2:18.3 R2:11.4
40-41	Understand the concept of methods for elliptic partial differential equations.	CLO 13	T2:33.4 R2:19.4
42-43	Understand the concept of Neumann and mixed problems.	CLO 14	T2:33.6 R2: 19.5
44	Analyze the concept of parabolic partial differential equations.	CLO 15	T2:33.7 R2:19.6
45	Analyze the concept of hyperbolic partial differential equations.	CLO 15	T2:33.9 R2:19.7

XVI. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance with POs
1	To improve standards and analyze the concepts.	Seminars	PO 1
2	Probability, Sampling distribution, ordinary and partial differential equations.	Seminars / NPTEL	PO 3
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2

Prepared By:
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