LAKIREDDY BALIREDDY COLLEGE OF ENGINEERING

(AUTONOMOUS)

(Approved by AICTE, Affiliated to JNTUK, Accredited by NBA, ISO 9001 : 2008 Certified & Accredited by **NAAC with "A" Grade)**

B.TECH. FOUR YEAR DEGREE COURSE
(Applicable for the batches admitted from 2011-12)

AEROSPACE ENGINEERING

L.B.Reddy Nagar :: Mylavaram – 521 230 :: Krishna District
ANDHRA PRADESH STATE

COURSE STRUCTURE

I-SEMESTER

Code No.	Name of the Course	Scheme of Instruction			Scheme of Examination		Total	Credits
		Periods per Week			Maximum Marks			
		Lectures	Tutorial	Lab	Internal	External		
T118	Applied Mathematics-I	4	1	--	25	75	100	4
T131	C Programming	4	1	--	25	75	100	4
T197	English-I	4	--	--	25	75	100	3
T264	Numerical Methods	4	1	--	25	75	100	4
T192	Engineering Graphics	2	--	5	25	75	100	4
P806	C Programming Lab	--	--	3	25	75	100	2
P812	Computer Aided Engineering Graphics	-	-	3	25	75	100	2
P831	Engineering Workshop	--	--	3	25	75	100	2
	TOTAL	**18**	**3**	**14**	**200**	**600**	**800**	**25**

II-SEMESTER

Code No.	Name of the Course	Scheme of Instruction			Scheme of Examination		Total	Credits
		Periods per Week			Maximum Marks			
		Lectures	Tutorial	Lab	Internal	External		
T119	Applied Mathematics- II	4	1	-	25	75	100	4
T198	English –II	4	-	-	25	75	100	3
T191	Engineering Chemistry	4	-	-	25	75	100	3
T193	Engineering Mechanics-I	4	1	-	25	75	100	5
T195	Engineering Physics	4	1		25	75	100	4
P832	English Language Communication Skills Lab	-	-	3	25	75	100	2
P830	Engineering Physics & Chemistry Lab	-	-	3	25	75	100	2
P845	Lab view	-	-	3	25	75	100	2
P856	Mini Project – I	--	--	2	25	25	50	2
	TOTAL	**20**	**3**	**11**	**225**	**625**	**850**	**27**

LBRCE EXAMINATION SECTION

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III-Semester

Code No.	Name of the Course	Scheme of Instruction			Scheme of Examination		Total	Credits
		Periods per Week			Maximum Marks			
		Lectures	Tutorial	Lab	Internal	External		
T194	Engineering Mechanics – II	4	1	--	25	75	100	4
T330	Thermodynamics	4	1	--	25	75	100	4
T356	Fluid Mechanics and Fluid Machines	4	1	--	25	75	100	4
T319	Strength of Materials	4	1	---	25	75	100	4
T354	Elements of Aerospace Engineering	4	--	--	25	75	100	4
T177	Electrical & Electronics Engineering	4	1	--	25	75	100	3
P835	Fluid Mechanics and Strength of Materials Lab	--	--	3	25	75	100	2
P821	Electrical & Electronics Lab	--	--	3	25	75	100	2
P870	Seminar – I	--	--	1	50	--	50	1
	TOTAL	**24**	**5**	**7**	**250**	**600**	**850**	**28**

IV-Semester

Code No.	Name of the Course	Scheme of Instruction			Scheme of Examination		Total	Credits
		Periods per Week			Maximum Marks			
		Lectures	Tutorial	Lab	Internal	External		
T108	Aerodynamics- I	4	1	--	25	75	100	4
T111	Aircraft Structures –I	4	1	--	25	75	100	4
T121	Applied Thermodynamics	4	1	---	25	75	100	4
T361	Manufacturing Technology	4	--	--	25	75	100	4
T199	Environmental Studies	4	--	--	25	75	100	4
T285	Probability & Statistics	4	1	-	25	75	100	4
P879	Thermal Engineering Laboratory	--	--	3	25	75	100	2
P885	Manufacturing Technology lab	--	--	3	25	75	100	2
P857	Mini Project – II	--	--	2	25	25	50	2
	TOTAL	**24**	**4**	**8**	**225**	**625**	**850**	**30**

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V-Semester

Code No.	Name of the Course	Scheme of Instruction			Scheme of Examination		Total	Credits
		Periods per Week			Maximum Marks			
		Lectures	Tutorial	Lab	Internal	External		
T292	Propulsion-I	4	1	--	25	75	100	4
T347	Aerodynamics- II	4	1	--	25	75	100	4
T113	Aircraft Systems and Instruments	4	--	---	25	75	100	4
T211	Heat Transfer	4	1	--	25	75	100	4
T132	CAD/CAM	4	--	--	25	75	100	4
T250	Metallurgy and Material Science	4	--	--	25	75	100	4
P803	Aerodynamics Laboratory	--	--	3	25	75	100	2
P836	Heat Transfer Lab	--	--	3	25	75	100	2
P871	Seminar – II	--	--	1	50	--	50	1
	TOTAL	**24**	**3**	**7**	**250**	**600**	**850**	**29**

VI-Semester

Code No.	Name of the Course	Scheme of Instruction			Scheme of Examination		Total	Credits
		Periods per Week			Maximum Marks			
		Lectures	Tutorial	Lab	Internal	External		
T355	Flight Dynamics	4	1	--	25	75	100	4
T112	Aircraft Structures-II	4	1	--	25	75	100	4
T293	Propulsion-II	4	1	--	25	75	100	4
T203	Finite Element Method	4	1	--	25	75	100	4
T325	Theory of Machines	4	1	---	25	75	100	4
T350 T363 T324 T358 T270	**ELECTIVE-I** Applied Gas Dynamics Space Mechanics Theory of Elasticity Hypersonic and High Enthalpy Flows Optimization Techniques	4	--	--	25	75	100	3
P805	Aircraft Structures Laboratory	--	--	3	25	75	100	2
P868	Propulsion Laboratory	--	--	3	25	75	100	2
P810	Comprehensive Viva-Voce – I	--	--	--	100	--	100	2
	TOTAL	**24**	**5**	**6**	**300**	**600**	**900**	**29**

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EXAMINATION SECTION

VII-Semester

Code No.	Name of the Course	Scheme of Instruction			Scheme of Examination		Total	Credits
		Periods per Week			Maximum Marks			
		Lectures	Tutorial	Lab	Internal	External		
T352	Composite Materials and Structure	4	1	--	25	75	100	4
T248	Mechanical Vibrations	4	1	--	25	75	100	4
T200	Experimental Stress Analysis	4	1	---	25	75	100	4
T359	Instrumentation Measurements and Experiments in Fluids	4	1	--	25	75	100	5
T230	Introduction to Computational Fluid Dynamics	4	1	--	25	75	100	4
T212 T326 T353 T362 T351	**ELECTIVE –II** Helicopter Aerodynamics Theory of Plates and Shells Control Engineering Satellite Technology Combustion	4	--	--	25	75	100	3
P884	Aircraft Component Modeling and Analysis Lab	--	--	3	25	75	100	2
P804	Aircraft Design Project	--	--	3	25	75	100	2
P843	Internship/Flight Training				50	--	50	2
P878	Term Paper	--	--	1	25	25	50	2
TOTAL		**24**	**5**	**7**	**275**	**625**	**900**	**32**

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VIII-Semester

Code No.	Name of the Course	Scheme of Instruction			Scheme of Examination		Total	Credits
		Periods per Week			Maximum Marks			
		Lectures	Tutorial	Lab	Internal	External		
T401	Principles of Management and Ethics	4	--	--	25	75	100	4
	ELECTIVE –III							
T130	Boundary Layer Theory							
T149	Cryogenics							
T202	Fatigue and Fracture Mechanics	4	--	--	25	75	100	3
T349	Airframe Repair and Maintenance							
T345	Advanced Propulsion Systems							
	ELECTIVE –IV							
T348	Aero Engine Repair and Maintenance							
T364	Wind Engineering							
T360	Launch Vehicle Aerodynamics	4	--	---	25	75	100	3
T357	High-Speed Jets							
T346	Aero Elasticity							
P867	Project Work	--	--	8	60	140	200	8
P811	Comprehensive Viva-Voce – II	--	--	2	100	--	100	2
	TOTAL	**12**	**--**	**10**	**235**	**365**	**600**	**20**

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I-SEMESTER

T118 APPLIED MATHEMATICS – I	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Differential equations of first order and first degree – exact, linear and Bernoulli. Applications to Newton's Law of cooling, Law of natural growth and decay, orthogonal trajectories.

UNIT - II

Linear differential equations of second and higher order with constant coefficients and with variable coefficients, method of variation of parameters and their simple applications to Simple Harmonic Motion and Electrical Circuits.

UNIT - III

Generalized Mean Value theorems (without proof), Functions of several variables, Maxima and Minima of functions of two variables with constraints and without constraints. Lagrangian Multiplier method.

UNIT - IV

Curve tracing – Cartesian curves. Applications of Integration to Lengths, Volumes and Surface areas of revolution in Cartesian Coordinates. Multiple integrals - double and triple integrals (Cartesian Coordinates only) – Changing of order of Integration. (Cartesian Coordinates only)

UNIT - V

Vector Differentiation: Gradient- Divergence - Curl and their related properties of sums-products - Laplacian and second order operators. Vector Integration - Line integral – work done – Potential function – area - surface and volume integrals Vector integral theorems: Greens, Stokes and Gauss Divergence Theorems (Without proof) and related problems.

TEXT BOOKS

1. Higher Engineering Mathematics by Dr. B.S. Grewal
2. Higher Engineering Mathematics by Dr. B. V. Ramana – TMGH

REFERENCES

1. Advanced Engineering Mathematics by M. D. Greenberg – TMGH
2. Advanced Engineering Mathematics by Erwin Krezig - John Wiley & sons
3. Elementary Differential equations by W. E. Boyce and R. C. Diprima - John Wiley & sons
4. Advanced Engineering Mathematics by Peter V. O. Neil – Thomson

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T131 C – PROGRAMMING	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Algorithm / pseudo code, flowchart, program development steps, structure of C program, A Simple C program, identifiers, basic data types and sizes, Constants, variables, arithmetic, relational and logical operators, increment and decrement operators, conditional operator, bit-wise operators, assignment operators, expressions, type conversions, conditional expressions, precedence and order of evaluation.
Input-output statements, statements and blocks, if and switch statements, loops-while, do-while and for statements, break, continue, goto and labels, programming examples.

UNIT - II

Designing structured programs, Functions, basics, parameter passing, storage classes- extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, header files, C preprocessor, example c programs.

UNIT - III

Arrays- concepts, declaration, definition, accessing elements, storing elements, arrays and functions, two dimensional and multi-dimensional arrays, applications of arrays. pointers- concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory managements functions, command line arguments, c program examples.

UNIT - IV

Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bitfields, C program examples.

UNIT - V

Input and output – concept of a file, text files and binary files, streams, standard I/o, Formatted I/o, file I/o operations, error handling, C program examples.

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TEXT BOOKS

1. Computer science, A structured programming approach using C, B.A. Forouzan and R.F. Gilberg, Third edition, Thomson.
2. The C Programming Language, B.W. Kernighan, Dennis M.Ritchie, PHI/Pearson Education

REFERENCES

1. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press
2. Programming in C – Stephen G. Kochan, III Edition, Pearson Eductaion
3. C and Data Structures:A Snap Shot Oriented Treatise Using Live Engineering Examples by Prof. N.B.Venkateswarlu and, Prof.E.V.Prasad, S Chand & Co, New Delhi
4. C/C++ for Engineers and Scientists, Harry H.Cheng ,McGrawHill,

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T197 ENGLISH – I	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	3	25	75	100

English Language continues to be regarded as an important tool for global communication and employability. Hence, it is imperative that students need to acquire communicative competence besides their core skills. The syllabus has been designed to develop linguistic and communicative competence of Engineering students with special emphasis on professional and functional aspects of English language i.e., on Listening, Speaking, Reading and Writing (LSRW Skills).

OBJECTIVES

- To improve the language proficiency of the students in English with emphasis on LSRW skills.
- To develop the study skills and Communication skills of the students in both formal and informal situations.
- To enable the students to face the academic and professional challenges of the present day scenario.
- To help students acquire the ability to speak effectively in English in the real life situations.
- To inculcate reading as a habit and to develop reading skills among students.
- To train students to improve their active and passive vocabulary.
- To familiarize the students with different rhetorical functions of Technical English.
- To enable the students write letters and reports effectively in formal and professional situations.

UNIT - I

Chapter – 1: "Read & Proceed" from Step by Step (*Pearson*)
Extensive Reading - Masterminds– The Trailblazers – **Jagadis Chandra Bose***(Orient Longman)*

UNIT - II

Chapter – 2: "Travel" from Step by Step (*Pearson*)
Extensive Reading - Masterminds– The World of Figures and Physics – **Chandra SekharaVenkata Raman** *(Orient Longman)*

UNIT - III

Chapter – 3: "Gender" from Step by Step (*Pearson*)
Extensive Reading - Masterminds–The Institution Builders– **Shanti SwarupBhatnagar** (*Orient Longman*)

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UNIT - IV

Vocabulary – Synonyms, Antonyms, Words often Confused, Gerunds & Infinitives, Prefixes & Suffixes, Word plurals, Analogy
Grammar – Parts of Speech, Sentence Completion, Question Tags, Tense and Aspect

UNIT - V

Analytical Writing – Sentence Construction – Types of sentences, Exercises with scrambled words & Jumbled sentences, Paragraph writing, Dialogue writing (Formal & Informal), Letter Writing (Formal & Informal), Resume writing, Expansion (of a given topic), Abstract Writing (Summarizing / Synopsis), Decision-making, Drafting E-Mails & Memo writing, Essay writing.

TEXT BOOKS

- Step by Step (*Pearson*)
- Masterminds by EnakshiChatterjee (*Orient Longman*)

REFERENCES

1. Andrea J Rutherford. *Basic Communication Skills for Technology*: Pearson Education, New Delhi, 2009.
2. Murphy. *English Grammar with CD*: Cambridge University Press, New Delhi, 2004
3. Rizvi, M Ashraf. *Effective Technical Communication*: Tata McGraw Hill, New Delhi, 2008.
4. Blum Rosen. *Word Power*: Cambridge University Press, New Delhi, 2009.

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LBRCE EXAMINATION SECTION

T264 NUMERICAL METHODS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Linear systems of equations: Rank-Echelon form, Normal form – Solution of Linear Systems – Direct Methods- Gauss Elimination - Gauss Jordon and Gauss Seidal Methods. Eigen values – Eigen Vectors – Properties – Cayley Hamilton Theorem – Inverse and Powers of a matrix by using Cayley Hamilton Theorem.

UNIT - II

Quadratic forms – Reduction to Canonical form – Rank and Nature of Quadratic form. Solution of Algebraic and Transcendental Equations: Introduction – The Method of False Position – Newton-Raphson Method.

UNIT - III

Interpolation: Introduction- Errors in Polynomial Interpolation – Finite differences- Forward Differences- Backward differences –Central differences – Symbolic relations and separation of symbols-Differences of a polynomial- Newton's formulae for interpolation – Lagrange's Interpolation formula.

UNIT - IV

Numerical Differentiation and Integration – Differentiation using finite differences – Trapezoidal rule – Simpson's 1/3 Rule –Simpson's 3/8 Rule.

UNIT - V

Numerical solution of Ordinary Differential equations: Solution by Taylor's series- Picard's Method of successive Approximations-Euler's Method-Runge- Kutta Methods –Predictor-Corrector Methods- Milne's Method. Curve fitting: Fitting a straight line –Second degree curve-exponential curve by method of least squares.

TEXT BOOKS

1. Higher Engineering Mathematics by Dr. B.S. Grewal
2. Higher Engineering Mathematics by Dr. B. V. Ramana – TMGH

REFERENCES

1. Introductory Methods of Numerical Analysis by S. S. Sastry – PHI
2. Numerical Methods for Engineers with programming and software application by Steven .C. Chopra and Ra. P. Canale – TMGH
3. Numerical Methods for scientific and engineering by M. K. Jain, S. R. K. Iyengar – New Age International ltd.

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T192 ENGINEERING GRAPHICS	L	T	P	Credits	Internal	External	TOTAL
	2	0	5	4	25	75	100

UNIT - I

INTRODUCTION TO DRAWING -- ENGINEERING CURVES

Introduction to Engineering Drawing- Instruments and their uses- Types of lines, Lettering and Dimensioning – BIS conventions –Geometrical Constructions - Construction of polygons.

Engineering Curves – Conic Sections- Ellipse, Parabola, Hyperbola- General method – Normal and Tangent. Cycloid curves - Cycloid, Epi-Cycloid and Hypo-Cycloid-Normal and Tangent.

UNIT - II

ORTHOGRAPHIC PROJECTIONS

Introduction-Principle and method of Orthographic Projections – Planes of projection – Four quadrants- First angle projection – Third angle of projection. Projections of Points in different quadrants.

PROJECTIONS OF STRAIGHT LINES:

Projections of Straight Lines parallel to both planes, parallel to one and inclined to the other reference plane.

UNIT - III

Projections of straight lines inclined to both the reference planes –True length of a line and its inclination- Traces of a line.

UNIT - IV

PROJECTIONS OF PLANES

Introduction – plane perpendicular to both the reference planes – plane perpendicular to one reference plane and parallel to other - plane perpendicular to one reference plane and inclined to other – oblique planes

UNIT - V

PROJECTIONS OF SOLIDS

Introduction- Types of solids –Simple positions- Axis inclined to one of the reference plane and parallel to the other.

TEXT BOOKS

1. Engineering Drawing, N.D. Bhat / Charitor publishers
2. Engineering Drawing, Narayana and Kannaiah / Scitech publishers.

REFERENCES

1. Engineering Drawing and Graphics – Venugopal –New Age publishers
2. Engineering Drawing by Dhananjay A. Jolhe, Tata McGraw Hill Publishers
3. Engineering Graphics for Degree by K.C. John, PHI Publishers
4. Engineering Drawing by M.B. Shah and B.C. Rana, Pearson Publishers

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P806 C - PROGRAMMING LAB	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

1. Write a programme in 'C' language to cover the following problems.
   a) Roots of Quadratic Equation.
   b) Example program which shows the usage of various Operators available in C Language.
   c) Example program which shows the usage of various preliminary Data types available in C Language.
   d) Example programs to illustrate the *order of* evaluation.

II) WRITE EXAMPLE PROGRAMS

a) To check whether the given year is leap year (or) not

b) Converting given two digit number into words using switch statement

c) To illustrate the usage of 'goto' statement.

d) Finding smallest& biggest number from the given set of 4 numbers using 'if' statement.

e) Calculate the student grade in the examination – assume suitable constraints.

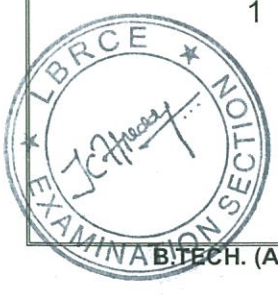
f) Prepare electricity bill for the consumed units – assume suitable constraints.

III) EXAMPLE PROGRAMS

a) To Display first N natural numbers
b) To find whether the given number is Armstrong (or) not
c) To find reverse of the given number and to check whether it is palindrome (or) not.
d) To find whether given number is strong number (or) not.
e) To check whether given number is Prime (or) not
f) To display prime numbers with in the given range(Nesting of Loops).
g) To display the following structure(Nesting of Loops)

i)
```
    1
  1   2
1   2   3
1   2   3   4
```

ii)
```
5 4 3 2
  4 3 2 1
    3 2 1
      2 1
        1
```



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IV) Write example programs in C Language:
a) To find factorial of a given number using functions.
b) Swap two numbers using functions.
c) To find GCD of two numbers using recursion
d) Write a recursive function to solve Towers of Honai problem.
e) Write an example program to illustrate use of external & static storage classes.

V) Write example programs in C Language to perform following operations:
a) Finding the sum and average of given numbers using Arrays.
b) To display elements of array in reverse order
c) To search whether the given element is in the array (or) not using linear search & binary search.
d) Write a C program to perform the following operations
i) Addition, subtraction and multiplication of Matrices
ii) Transpose of given matrix (The above operations are to be exercised using functions also by passing arguments)
e) Write a C program to find whether the given string is palindrome (or) not.
f) To accept line of text and find the number of characters, number of vowels and number of blank spaces in it.
g) Write an example program to illustrate the use of any 5 string handling functions.

VI) a) Example program to bring clarity on pointer declaration & initialization and Pointer arithmetic.
b) Write an example program to describe the usage of call by reference.
c) Write a program to find sum of the elements of the array using functions.
d) Write an example program to illustrate the usage of command line arguments.
e) Program to illustrate the usage of dynamic memory management functions.

VII) a) Write an example program using structures to process the student record. Assume suitable fields for student structures (Different kinds of initialization of structure variables are to be exercised)
b) Write a program to read records of 10 employees and find their average salary (exercise array of structures & Nested structures concepts through this program).
c) Write a program to handle a structure variable using pointers and implement self referential structure(i.e. A structure variable having a pointer to itself)

VIII) Write an example program on file to perform following operations:
a) Accessing content from files and writing content in to it. (Exercise different file operation modes)
b) Copy the contents of one file into another (Exercise different file operation modes)

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P812 COMPUTER AIDED ENGINEERING GRAPHICS	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

UNIT - I

COMPUTER AIDED DRAFTING

Introduction - Computer Aided drafting system – Advantages, Applications of AUTOCAD. Drafting software – AUTOCAD – Advantages, Initial setup commands, utility commands, Drawing Aids, Entity Draw commands, Display commands, Edit Commands.

Introduction Lettering – Basic types of Dimensioning, Linear, Angular and Radial Dimensioning.

UNIT - II

ORTHOGRAPHIC PROJECTIONS:

Introduction to orthographic Projections

Projections of Solids: Types of Solids, Prisms, pyramids , solids of revolution-simple positions Sections of Solids : Introduction – section & section planes – Types of section planes – True shape of a section.

UNIT - III

ISOMETRIC DRAWING :

Introduction - Theory of Isometric projection, Isometric view and Isometric drawing. Non – Isometric Lines – Methods to generate an Isometric Drawing.

UNIT - IV

DEVELOPMENT OF SURFACES OF SOLIDS:

Introduction – Theory of development - Methods of developments – Developments of lateral surfaces along with base.

UNIT - V

INTERSECTION OF SURFACES:

Introduction – Rules for visibility – Line of intersection – Intersection of Lines & Solids – Intersection of plane Vs plane - Intersection of surfaces of two solids, Interpenetration of two solids.

TEXT BOOKS

1. Engineering Graphics with AutoCAD by Bethune PHI Learning Private Limited, New Delhi, 2009.
2. Engineering Graphics with AutoCAD by M. Kulkarni, A.P Rastogi, and A.K. Sarkar; PHI Learning Private Limited, New Delhi, 2009.
3. Engineering Drawing, N.D. Bhat / Charitor

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P831 ENGINEERING WORKSHOP	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

TRADES FOR EXERCISES: (Common to EEE, ECE, CSE, EIE & IT)

At least three exercise from each trade :

1. Carpentry
2. Fitting
3. House – Wiring
4. Plumbing

TRADES FOR EXERCISES : (MECHCHANICAL ENGINEERING)

At least two exercise from each trade :

1. Carpentry
2. Fitting
3. Tin - Smithy
4. Black - Smithy
5. House - Wiring
6. Plumbing

TEXT BOOK

Workshop manual / P. Kannaiah / K.L. Narayana Scitech Publications, India Pvt Ltd, Chennai.

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II-SEMESTER

T119 APPLIED MATHEMATICS – II	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Laplace transforms of standard functions –Shifting Theorems, Transforms of derivatives and integrals – Unit step function –Dirac's delta function. Inverse Laplace transforms– Convolution theorem - Applications of Laplace transforms to ordinary differential equations

UNIT - II

Fourier Series: Determination of Fourier coefficients – Fourier series – even and odd functions – Fourier series in an arbitrary interval– Half-range sine and cosine series.

UNIT - III

Fourier integral theorem (only statement) – Fourier sine and cosine integrals – Fourier transform – sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms.

UNIT - IV

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions –solutions of first order linear (Lagrange) equation. Method of Separation of Variables - Applications to wave equation one dimensional, heat equation and Laplace Equation.

UNIT - V

Z-transform – properties – Damping rule – Shifting rule – Initial and final value theorems - Inverse z-transform -Convolution theorem – Solution of difference equation by z-transforms.

TEXT BOOKS

1. Higher Engineering Mathematics by Dr. B.S. Grewal
2. Higher Engineering Mathematics by Dr. B. V. Ramana – TMGH

REFERNCES

1. Advanced Engineering Mathematics by Michael D. Greenberg – TMGH
2. Advanced Engineering Mathematics by Erwin Krezig - John Wiley & sons

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T198 ENGLISH – II	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

English Language continues to be regarded as an important tool for global communication and employability. Hence, it is imperative that students need to acquire communicative competence besides their core skills. The syllabus has been designed to develop linguistic and communicative competence of Engineering students with special emphasis on professional and functional aspects of English language i.e., on Listening, Speaking, Reading and Writing (LSRW Skills).

OBJECTIVES

- To improve the language proficiency of the students in English with emphasis on LSRW skills.
- To develop the study skills and Communication skills of the students in both formal and informal situations.
- To enable the students to face the academic and professional challenges of the present day scenario.
- To help students acquire the ability to speak effectively in English in the real life situations.
- To inculcate reading as a habit and to develop reading skills among students.
- To train students to improve their active and passive vocabulary.
- To familiarize the students with different rhetorical functions of Technical English.
- To enable the students write letters and reports effectively in formal and professional situations.

UNIT - I

Chapter 4: "Disaster Management" from *Step by Step* (Pearson)
Extensive reading – *Masterminds* - The institution builders - **MeghanadSaha** *(*Orient Longman*)*

UNIT - II

Chapter 5: "Health" from *Step by Step* (Pearson)
Extensive reading – *Masterminds*- The New Age – **HomiJehangirBhabha** *(*Orient Longman*)*

UNIT - III

Chapter 6: "Sports" from *Step by Step* (Pearson)
Extensive reading – *Masterminds* - The New Age – **Vikram Sarabhai** *(*Orient Longman*)*

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UNIT - IV

Grammar – Articles, Prepositions, Voice, Speech, Concord, Correction of Sentences
Vocabulary – Phrasal verbs, Gerunds, Infinitives, One word Substitutes.

UNIT - V

Analytical writing – Comprehension, Technical dialogue writing,
Presentation skills - Note making, Information transfer / Data interpretation (Tables, Pie-charts, Bar graphs, Tree diagrams, Pictograms, etc.), Report writing

TEXTBOOK

Step by Step, Pearson Education, New Delhi 2010.
Master Minds, *(*Orient Longman*).*

REFERENCES

1. KoneruAruna. *Professional Communication:* Tata McGraw-Hill, New Delhi, 2007.
2. Effective Technical Communication, Rizvi, Tata McGraw-Hills, New Delhi, 2009.
3. Basic Communication Skills for Technology, Andrea J. Rutherford, Pearson Education.
4. GRE and TOEFL, Kaplan and Baron's, Latest editions.

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LBRCE EXAMINATION SECTION

T191 ENGINEERING CHEMISTRY	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	3	25	75	100

T191 - ENGINEERING CHEMISTRY

Lecture : 3 Periods/week | **Internal Marks** : 25

External Marks : 75

Credits : 3 | **External Examination** : 3 Hrs

UNIT - I

WATER TECHNOLOGY: Introduction, Hardness of Water - Temporary and Permanent hardness. Units and inter conversions of Units. Problems on Temporary and Permanent hardness. Boiler troubles – scale & sludge formation, Caustic embrittlement, Corrosion, priming & foaming, softening of water Methods of Treatment of Water for Domestic Purposes - Sedimentation, Coagulation, Filtration, Disinfection – Sterilization, Chlorination, Break point chlorination, Ozonization.

Water Treatment: Internal Treatment - Colloidal, Phosphate, Calgon, Carbonate, Sodium aluminates Conditioning of Water. External Treatment - Lime-Soda Process, Zeolite Process, Ion- Exchange Process.

UNIT - II

FUELS AND COMBUSTION: Definition and classification of Fuels- conventional fuels (solid, liquid, gaseous), Solid fuels- coal - analysis, Proximate and ultimate analyses of coal – significances, Liquid Fuels – primary- petroleum- refining of petroleum- cracking, knocking, synthetic petrol – Bergius and Fischer Tropsech's process; Gaseous fuels- octane number – cetane number,– water gas, producer gas CNG, and biogas - gross and net calorific values – (definition only) – flue gas analysis – Orsat's apparatus.

UNIT - III

CORROSION: Definition, Examples, Types of Corrosion: Theories of Corrosion and Mechanism - Dry Corrosion (Direct Chemical corrosion), Wet Corrosion (Electro Chemical corrosion) Principles of Corrosion, Galvanic Series, Galvanic Corrosion, Concentration Cell Corrosion, Mechanism of Wet and Chemical Corrosion - Hydrogen evolution type, Oxygen absorption type. Factors Influencing Corrosion. Control of Corrosion - Proper Design, Use of pure metal and metal alloys, Passivity, Cathodic Protection - Sacrificial anode and Impressed Current, Modifying the Environment and use of Inhibitors.

UNIT - IV

Polymer Science and Technology: Types of polymerization, Mechanism (Chain growth & step growth), Plastics –Thermosetting and Thermoplastic resins – preparation, properties and engineering applications of Polyethylene, PVC, Polystyrene, Teflon, Bakelite, Nylon, Conducting polymers: polyacetylene, polyaniline, conduction, doping, application. Characteristics and uses Rubber - Natural Rubber, Vulcanization and significance, Elastomers – Buna S, Buna N, Thiokol, Fibers- Polyester, fiber reinforced plastics (FRP), applications.

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UNIT - V

1. REFRACTORIES & INSULATORS: Definition, Classification with Examples, Criteria of a Good Refractory Material, Causes for the failure of a Refractory Material, Insulators – Definition and Classification with Examples. Characteristics of Insulating Materials, Thermal Insulators, Electrical Insulators - Their Characteristics and Engineering Applications.

2. LUBRICANTS: Introduction to Lubricants, Principles and function of lubricants - Types of Lubrication and Mechanism - Thick Film or Hydrodynamic Lubrication, Thin Film or Boundary Lubrication, Extreme Pressure Lubrication. Classification and properties of lubricants-Viscosity, flash and fire point, cloud and pour point, aniline point, Neutralization Number and mechanical strength, Selection of lubricants.

TEXT BOOKS

1. A text book of Engineering Chemistry by Jain & Jain, Dhanpat Rai Publishing Company, New Delhi (15th Edition) (2006).
2. A Text book of Engineering Chemistry by Dr. Y. Bharathi Kumari and Dr. Jyotsna Cherukuri, VGS Publications, First Edition, 2009.

REFERENCES

1. A Text book of Engineering Chemistry by Shashi Chawla, Dhanpat Rai Publishing Company, First Edition, 2002.
2. Advanced Engineering Chemistry by Dr. M. R. Senapati, University Science Press (Impart from Laxmi Publications), 3rd Edition 2009.
3. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, Engineering Chemistry, 2nd Edition. PHI Learning PVT., LTD, New Delhi, 2008.
4. A Text book of Engineering Chemistry by S. S. Dara, S CHAND Publications.

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LBRCE EXAMINATION SECTION

T193 ENGINEERING MECHANICS – I	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	5	25	75	100

UNIT - I

Introduction to Engg. Mechanics – Basic Concepts.
Resultant of Systems of Forces: Resultant of Coplanar Concurrent Forces – Resultant of Coplanar Non-Concurrent Forces.
Moments: Introduction to Moment, Moment of Force and its Applications, Principle of moments – Couples and Resultant of Force Systems.

UNIT - II

Equilibrium of Systems of Forces: Free Body Diagrams, Equations of Equilibrium of Coplanar Systems, Lami's Theorem, conditions of equilibrium.

UNIT - III

FRICTION: Introduction, Classification of friction, Laws of friction. Co-efficient of friction, Angle of friction, Angle of repose, Frictional forces on motion of bodies, Wedge friction.

UNIT - IV

Centroid: Centroids of simple figures (from basic principles) – Centroids of Composite Figures
Centre of Gravity: Centre of gravity of simple bodies (from basic principles), centre of gravity of composite Bodies.

UNIT - V

AREA MOMENT OF INERTIA
Moment of Inertia of a plane figure with respect to an axis in its plane–Moment of inertia with respect to an axis perpendicular to the plane of the figure – Parallel axis theorem, Moment of Inertia of composite figures.

TEXT BOOKS

1. Engineering Mechanics / Fedinand . L. Singer / Harper – Collins
2. Engineering. Mechanics / Timoshenko, Young and Rao – TATA Mc Graw Hill.

REFERENCES

1. Engineering. Mechanics / S.S. Bhavikatti – NEW AGE
2 Engineering Mechanics / AK Tayal. ,Umesh Publications
3 Vector Mechanics for Engineers Statics and Dynamics by Beer and Johnston, TATA Mc Graw Hill.

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T195 ENGINEERING PHYSICS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

INTERFERENCE: Superposition of waves-double slit interference- Young's double slit experiment- Coherence – Interference from thin films- Newton's rings.
DIFFRACTION: Diffraction and wave theory of light (Fresnel and Fraunhofer diffractions) - single slit Diffraction, Intensity in single- slit diffraction, Calculating the intensity– Double slit interference and diffraction combined.
GRATINGS AND SPECTRA - Multiple slits-width of the maxima, Diffraction gratings, Grating spectrum – Dispersion and Resolving power.
POLARIZATION: Polarization by reflection Brewster's law - Double refraction -Polarization by scattering - Retarders -Optical Activity.

UNIT - II

CRYSTAL STRUCTURES: Introduction –periodic arrays of atoms-Lattice translation vectors, Basis and crystal structure, Primitive cell, fundamental types of lattices-three dimension lattice types, Crystal systems- Structure and packing fractions of Simple cubic-Body centered cubic- Face centered cubic crystals.
X-RAY DIFFRACTION: Directions and planes in crystals – Miller indices – separation between successive (h k l) planes- Diffraction of X- rays by crystal planes – Braggs law-Laue method- powder method.

UNIT - III

LASERS: Introduction – Characteristics of Lasers- Principle of laser (Absorption, Spontaneous and stimulated emission of Radiation), Einstein Coefficients- Population Inversion - Helium Neon Laser, Semiconductor laser, Applications of Lasers.
FIBER OPTICS: Introduction- Principle of optical Fiber- Acceptance angle and Acceptance cone- Numerical aperture - refractive index profile-Application of optical fibers.

UNIT - IV

SUPER CONDUCTIVITY : Phenomenon, Meissner effect, critical parameters, Type I, Type II Super conductors, BCS theory of super conductivity, Applications of Super conductors.

UNIT - V

NON-DESTRUCTIVE TESTING USING ULTRASONICS: Characteristics Production and detection of ultrasonics-Piezoelectric and magnetostirictionmethods,Ultrasonic Testing - Basic Principle –Transducer – Couplant and inspection Standards – Inspection Methods – Pulse echo Testing Technique – Flaw detector- Different Types of Scans – Applications.

TEXT BOOKS

1. Fundamentals of physics Resinic, Halliday and Krane, John Wiley 2003
2. Engineering Physics by V RAJENDRAN TataMcGrahill

REFERENCES

1. Introduction to solid state physics, C. Kittel, John wiley, 1999.
2. Engineering physics by H K MALIK AK SINGH TATA McGRAHILL

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P832 ENGLISH LANGUAGE COMMUNICATION SKILLS LAB	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

The English Language Communications Skills Lab focuses on practice of sounds of language and familiarizes the students with the use of English in everyday situations and contexts. It aims at improving the communicative competence of students and to enrich their power of expression, articulation and persuasiveness. The thrust is on developing competences, both linguistic as well as communicative, in order to improve employability potential.

OBJECTIVES

1. To expose the students to a variety of self-instructional, learner-friendly modes of English language learning and stimulate intellectual and attitudinal exercise.
2. To provide students with the required facility and practice to face computer-based competitive exams such GRE, TOEFL, IELTS etc.
3. To enable them to learn better pronunciation through emphasis on word accent, intonation, and rhythm.
4. To train them to use language effectively to face interviews, group discussions, public speaking.
5. To develop necessary attitudes and behaviors so as to improve their employability quotient.

SYLLABUS

The following course content is prescribed for the English Language Communication Skills Laboratory sessions:

1. Dimensions of Phonetics: Phonetic Transcription, Sounds, Stress, Intonation, Rhythm, Varieties of Spoken English: Indian, British and American
2. Oral Presentations -- Prepared and Extempore -- JAM
3. Role Play
4. Describing Objects / Situations / People
5. Information Transfer
6. Debates
7. Group Discussions

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SUGGESTED SOFTWARE/BOOKS

* *Digital Mentor*, Globarena, Hyderabad, 2005
* *Sky Pronunciation Suite: Young India Films, Chennai, 2009*
* Mastering English in Vocabulary, Grammar, Spelling, Composition, Dorling Kindersley, USA, 2001
* Dorling Kindersley Series of Grammar, Punctuation, Composition, Dorling Kindersley, USA, 2001
* *Oxford Talking Dictionary,* The Learning Company, USA, 2002
* *Cambridge Advanced Learners English Dictionary* (with CD). Cambridge University Press, New Delhi, 2008.
* Learning to Speak English - 4 CDs. The Learning Company,USA,2002
* Herbert Puchta and Jeff Stranks with Meredith Levy: *English in Mind*: Cambridge University Press, New Delhi, 2009.
* Krishna Mohan, Effective English Communication, Tata McGraw Hills, New Delhi,2007

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P830 ENGINEERING PHYSICS AND CHEMISTRY LAB	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

ENGINEERING PHYSICS LABORATORY
(Any 5 experiments)

LIST OF EXPERIMENTS

1. LCR Resonance circuit
2. Newton's Rings – Determination of Radius of curvature of plano convex lens
3. Verification of laws by using sonometer
4. Meldy's experiment
5. Wedge shaped film
6. Volume Resonator
7. Refractive index of light
8. Diffraction Grating – Normal incidence method
9. Rigidity modulus of a given wire
10. Frequency of AC supply – Sonometer

ENGINEERING CHEMISTRY LABORATORY
(Any 5 experiments)

1. Estimation of total Hardness of water by EDTA method
2. Determination of Temporary and permanent hardness of water.
3. Iodometric Titration of $K_2Cr_2O_7$ v/s $Na_2S_2O_3$ to determine the percentage purity of $K_2Cr_2O_7$ sample.
4. Preparation of Stanard Potassium Dichromate and Estimation of Copper by Iodometry.
5. Determine the amount of Oxalic acid and Sulphuric acid in 1 liter solution by using given standard Sodium Hydroxide and Potassium Permanganate solution
6. Determination of alkalinity of water sample.
7. Determination of Dissolved Oxygen (DO) content by Winkler's method.
8. Preparation of Urea formaldehyde resin.

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P845 LAB. VIEW	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

LAB - I

Exercise 1. Open and Run a VI
Objective: Open, run, and explore the components of a VI.
Open the Temperature System Demo VI from the tutorial_1 directory.

Exercise 2. Use of LabVIEW help utilities
Objective: Become familiar with the context help and the LabVIEW help
Open the Temperature System Demo VI from the tutorial_1 directory if it is not already open from Exercise 1.

Exercise 3. Create a VI
Objective: Build a simple VI that converts a Celsius temperature reading to Fahrenheit.

Exercise 4. Document a VI
Objective: Document a VI that you have created.

Exercise 5. Navigation and editing
Objective: To learn LabVIEW editing techniques.

Exercise 6. Debug a VI
Objective: To use the probe tool and the probe window and to examine data flow in the block diagram using execution highlighting.

LAB - II

Converting a VI into a sub VI (Exercise)
Use of sub-VI (demo)
Debug a VI (Demo)
Debug Main (Exercise)
Mechanical action of Boolean (Demo)
While Loop & Charts (exercise)
While Counter (Exercise)
Moving averages (Exercise)
Shift Register (Exercise)
Die Roller (Exercise)

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LAB - III

Case structure (Demo)
Calculator
SEQUENCE STRUCTURE
Building arrays with loops (Demo)
Building arrays with loops (Exercise)
Build array function (demo)
Building Tables (demo)
Replace array elements
Sort array values
Temperature Analysis

LAB - IV

Case structure (Demo)
Calculator
SEQUENCE STRUCTURE
CLUSTER ERROR. FIND AND RECTIFY?
BUTTON SELECTION (Demo)
BUTTON SELECTION with Shift Register (Demo)
LOCALS FOR PARALLEL LOOP CONTROL
LOCAL FOR RESET
LOCALS FOR CONTROL
Global Variables (Demo)
Function Generator (demo)
Noisy Signal (Demo)
Noisy Signal Analyzer (Demo)
Noisy Signal Analyzer with Filter (Demo)

LAB - V

Modeling and simulation of Physical Systems

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III-SEMESTER

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T194 ENGINEERING MECHANICS-II	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

MASS MOMENT OF INERTIA: Moment of inertia of a rigid body – Moment of inertia of lamina- slender bar, rectangular plate, Circular plate, circular ring, Moment of inertia of 3D bodies- cone, solid cylinder, solid sphere. Moment of Inertia of composite bodies.

UNIT - II

KINEMATICS: Introduction, displacement, velocity and acceleration. Motion with Uniform and Variable acceleration. Angular displacement, Angular velocity and Angular acceleration. Equations of Motion along a circular path.

UNIT - III

PROJECTILES: Introduction, Basic Definitions, Projectile equations, Horizontal projection, Inclined Projection, Projectile on Horizontal plane and Inclined plane.

UNIT - IV

KINETICS: Equations of rectilinear motion. Equations of Dynamic Equilibrium, D'Alembert's Principle, Motion of connected bodies, Bodies in curvilinear translation, Kinetics of bodies rotating about fixed axis, Kinetics of rolling bodies.

UNIT - V

Work – Energy Method: Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion.

TEXT BOOK

Engineering Mechanics / Fedinand . L. Singer / Harper – Collins

REFERENCES

1. Engg. Mechanics / S.S. Bhavikatti – NEW AGE
2 Engg. Mechanics / Timoshenko, Young and Rao – TATA Mc Graw Hill.
3. Engg. Mechanics / AK Tayal.
4. Vector Mechanics for Engineers Static's and Dynamics by Beer and Johnston, TATA Mc Graw Hill.

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T330 THERMODYNAMICS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Basic Concepts and Definitions: Introduction, Macroscopic and Microscopic View Point, Continuum, System, Control Volume, Properties of System, State and Equilibrium-Thermodynamic Equilibrium, Processes –Quasi static process, Cycle, Temperature-Temperature Scales, Zeroth law of Thermodynamics, Energy-Forms of Energy, Heat, Work, Mechanical forms of Work, Path and Point Functions.

UNIT - II

First Law of Thermodynamics: Introduction, Energy Change of System, First Law Analysis of Closed System- Moving Boundary Work –Polytrophic Process, Energy Balance, Internal Energy, Specific Heat

First Law Analysis of Control Volume-Conservation of Mass, Conservation of Energy Principle-Flow work, Total Energy of Flowing Fluid, The Steady Flow Process-Steady Flow Energy Equation, Steady Flow Engineering Devices-Nozzles, Diffusers, Turbine, Compressors, Throttling Valves, Heat Exchangers.

UNIT - III

Second Law of Thermodynamics: Introduction, Thermal Energy Reservoirs, Heat Engines, Kelvin-Plank & Clasius Statements of Second law of Thermodynamics, Refrigerators, Heat Pumps, Equivalence of Kelvin-Plank and Clasius Statements, Perpetual Motion Machines, Reversible and Irreversible Process, Carnot Cycle, Carnot Principles, Thermodynamic Temperature Scale.

Entropy: Introduction, Clasius Inequality, Property Diagrams, Tds-Relations, Maxwell Relation, Entropy Change for Ideal gases, Isentropic relations for ideal gases, Principle of Increase of Entropy-Closed and Control Volumes, Third Law of Thermodynamics.

UNIT - IV

Non Reactive Gas Mixtures: Introduction, Composition of Gas Mixture, Mass Fraction, Mole Fraction, Daltons Law of Additive Pressures, Amagat`s Law of Additive Volumes, Ideal Gas Mixtures.

Pure Substance: Introduction, Phases of Pure Substance, Phase Change Processes, Property Diagrams (T-v, P-v, P-T), P-v-T Surface, Property Tables.

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UNIT - V

Gas Power Cycles: Introduction, Analysis of Power Cycles- Carnot, Otto, Diesel, Dual, Stirling, Atkinson, Ericsson, Lenoir and Brayton.
Vapor Power Cycles: Analysis of Carnot Vapor Cycle, Simple Rankine Cycle.
Refrigeration Cycles: Reveresd Carnot Cycle, Bell-Coleman Cycle, Simple Vapor Compression Cycle.

TEXT BOOK

Fundamentals of Engineering Thermodynamics- Second Edition, E. Rathakrishnan- PHI

REFERENCES

1. Thermodynamics: An Engineering Approach—Cengel, Y.A and Boles, M.A. McGraw-Hill
2. Fundamentals of Classical Thermodynamics – G.J.Van Wylen & Sonntag.TMH
3. Engineering Thermodynamics – P.K.Nag, TMH

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LBRCE EXAMINATION SECTION

T356 FLUID MECHANICS AND FLUID MACHINES	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Introduction: General description of Fluid Mechanics, Classification of Fluids, Fluids and Continuum, Properties of Fluid – Pressure, Temperature, Density, Specific Weight, Specific Gravity, Viscosity, Compressibility, Surface Tension, Capillarity, Vapor Pressure

Fluid Statics: Pressure Force on a Fluid Element, Hydrostatic Pressure Distributions, Hydrostatic forces on submerged plane and curved surfaces, Manometers, Buoyancy and Stability

UNIT - II

Analysis of Fluid Flow: Eulerian and Lagrangian approaches, Velocity Field, Flow Patterns- Pathline, Streamline, Streakline, Timeline, Stream Tube

Differential Relations for Fluid Flow: Acceleration Field of a Fluid, Differential Equation of Mass Conservation, Differential Equation of Linear Momentum, Euler's Equation, Stream Function, Vorticity and Irrotationality, Velocity Potential, Rotationality, Potential Flow, Bernoulli Equation and Its Applications-Venturi meter, Orifice meter, Limitations on the use of the Bernoulli equation

UNIT - III

Flow Through Pipes: Introduction, Reynolds number and its importance, Reynolds Experiment, , Head loss, Darcy-Wiesbach equation, Hydraulic Gradient and Total Energy Lines, Laminar Fully Developed Pipe Flow- Hagen Poiseuille Law, Moody Chart , Pipes in Series, Equivalent Pipe, Pipes in Parallel, Minor Losses, Hydraulic Diameter

Dimensional Analysis and Similarity: Introduction, Principle of Dimensional Homogeneity, Buckingham's Pi Theorem, Dimensionless Groups, Similarity.

UNIT - IV

Hydraulic Turbines: Introduction, Classification of turbines- impulse and reaction turbines, Pelton Turbine, Francis Turbine and Kaplan Turbine-working principle, Work Done and Efficiency, Draft tube

Performance of Hydraulic Turbines: Geometric similarity, Unit and specific quantities, Characteristic curves, Governing of turbines, Selection of type of Turbine, Cavitation, Surge Tank, Water Hammer.

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UNIT V

Reciprocating Pumps: Classification, Working Principle, Co-efficient of Discharge and Slip, Indicator Diagram

Centrifugal Pumps: Classification, Working Principle, Work done, Head and Efficiencies, Losses, Specific Speed, Pumps in Series and Parallel, Performance Characteristics

TEXT BOOK

Fluid Mechanics, White F.M. Tata McGraw-Hill

REFERENCES

1. Fluid Mechanics-E. Rathakrishnan- Third Edition, PHI, 2012
2. Introduction of Fluid Mechanics, Fox, R.W., and Mcdonald, A.J
3. Fluid Mechanics, Douglas, J.F., Gesiorek, J.M., and Swaffield, J, A., 4th ed., Pearson Education, 2002
4. Engineering Fluid Mechanics, P. Balachandran, PHI, 2012
5. Mechanics of Fluids, Shames, H., McGrawHill

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LBRCE EXAMINATION SECTION

T319 STRENGTH OF MATERIALS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

SIMPLE STRESSES AND STRAINS: Stresses and strain due to axial force. Hooke's law, factor of safety, stepped bars – uniformly varying sections - stresses in composite bars due to axial force and temperature - strain energy due to axial force, stresses due to sudden loads and impact. Lateral strain: Poisson's ratio - change in volume – shear stress - shear strain - relationship between elastic constants

UNIT - II

SHEAR FORCE AND BENDING MOMENT: Relationship between loading - shear force and bending moment - shear force and bending moment diagrams for cantilever, simply supported and overhanging beams subjected to concentrated loads and uniformly distributed loads only - maximum bending moment and point of contra flexure.

UNIT - III

STRESSES IN BEAMS: Theory of simple bending: assumptions - derivation of the equation M/I = E/R = f/y – section modulus - calculation of normal stresses due to flexure application.
TORSION: Theory of torsion and assumptions - derivation of the equation T/J = Cθ/L = q/r, polar modulus, power transmitted by a shaft, stresses in solid and hollow circular shafts

UNIT - IV

ANALYSIS OF STRESSES IN TWO DIMENSIONS: State of stress at a point, normal and tangential stresses on inclined planes - principal stresses and their planes - plane of maximum shear - Mohr's circle of stresses.
SHEAR STRESSES: Derivation of formula – Shear stress distribution across various beam cross sections like Rectangular, Circular, Triangular, I and T Sections.

UNIT - V

DEFLECTION OF BEAMS: Differential equation of elastic line - deflection in statically determinate beams - Macaulay's method for prismatic members - area moment method for stepped beams with concentrated loads.
THIN, THICK AND SPHERICAL SHELLS: Hoop and longitudinal stress- thin and thick cylinders- spherical shells-changes in dimensions and volume.

LBRCE EXAMINATION SECTION

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TEXT BOOK

S.Ramamrutham, Strength of Materials, Dhanpat Rai & Sons

REFERENCES

1. Popov, E.P., Mechanics of Materials, Prentice Hall Inc., 1976.
2. Andrew, P. and Singer, F.L., icsStrength of Materials, Harper and Row Publishers, New York, 1987.
3. M.L.Gambhir, Fundamentals of Solid Mechanics, PHI Learning.
4. R.Subramanian, Strength of Materials, Oxford University Press

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LBRCE EXAMINATION SECTION

T354 ELEMENTS OF AEROSPACE ENGINEERING	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	4	25	75	100

UNIT - I

History-Early planes, Components of Airplane and their functions, Types Flight Vehicles, Classifications, Standard Atmosphere, Altitude, Hydrostatic Equation, Geopotential and Geometric Altitudes

UNIT - II

Basic Aerodynamics: Introduction, Fundamental Concepts of Aerodynamics, Aerofoils, Aerofoil Nomenclature, Classifications of NACA aerofoils, Wing Geometry, Aerodynamic Forces, Lift, Drag and Moment Co-efficients, Co-efficient of Pressure, Aerodynamics Center, Pressure Distribution on Aerofoil, Types of Drag, High Lift Devices

UNIT - III

Propulsion: Introduction, Propeller, Reciprocating Engine, Jet Propulsion-The Thrust Equation, Elements of Turbojet Engine-Turbofan Engine-Rocket Engine, Rocket Propellants-Liquid Propellants, Solid Propellants, Rocket Staging

UNIT - IV

Aircraft Structure and Material: Introduction, Fluselage-Monocoque, Semi-Monocoque Structures, Components of Wing-Spars, Ribs, Longerons, Stringers, Bulkheads, Aircraft Materials-Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials.

UNIT - V

Space Flight: Introduction, Orbit Equation, Basic Aspects of Space Vehicle Trajectories, Kepler's Laws, Earth and Planetary Entry, Space Explorations- space vehicles and its types, reusable space vehicles, space shuttle, satellites, Types of satellites and their functions

TEXT BOOK

Introduction to Flight, John D. Anderson, Jr., McGrawHill

REFERENCES

1. Aerodynamics for Engineering Students, Houghton and Carpenter
2. Mechanics of Flight, A.C. Kermode

LBRCE EXAMINATION SECTION

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T177 ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

Electrical Circuits: Basic definitions, Types of elements, Ohm's Law, Resistive networks, Kirchhoff's Laws, Inductive networks, capacitive networks, Series, Parallel circuits and Star-delta and delta-star transformations

UNIT - II

AC Machines: Principle of operation of alternators – regulation by synchronous impedance method – MMF and zero power factor methods. Principle of operation of induction Principle of operation of three-phase induction motors –Slip ring and Squirrel cage motors – Slip-Torque characteristics

UNIT - III

Transformers: Principle of operation of single phase transformers, Ideal transformer, Practical transformer, phasor diagram.– emf equation – losses – efficiency and regulation..

UNIT - I V

Diode and Transistors: P-n junction diode, symbol, V-I Characteristics, Diode Applications, Rectifiers – Half wave, Full wave and Bridge rectifiers (simple Problems).PNP and NPN Junction transistor, Transistor as an amplifier, SCR characteristics and applications.

UNIT - V

Electrical and Electronics Measuring Instruments.
Electrical Instruments: Basic Principle of indicating instruments – permanent magnet moving coil and moving iron instruments.
Electronic Instruments: Principles of CRT (Cathode Ray Tube), Deflection, Sensitivity, Electrostatic and Magnetic deflection, Applications of CRO - Voltage, Current and frequency measurements.

TEXT BOOK

Essentials of Electrical and Computer Engineering by David V. Kerns, JR. J. David Irwin/Pearson.

REFERENCES

1. Introduction to Electrical Engineering-M.S Naidu and S. Kamakshaiah,TMH Publ.
2. Basic Electrical Engineering by Kothari and Nagarath, TMH Publications, 2nd Edition.
3. Electrical Technology by JB GUPTA

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P835 FLUID MECHANICS AND STRENGTH OF MATERIALS LAB	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

Any of the 5 Experiments are required to be conducted from each section

✓FLUID MECHNAICS

1. Calibration of Orifce and Mouth Piece
2. Calibration of Venturimeter and Orifice meter
3. Verification of Bernollious Theorem
4. Determination of friction factor for a given pipe line
5. Determination of loss of head due to sudden contraction in a pipeline
6. Impact of jets on Vanes.
7. Performance Test on Pelton Wheel.
8. Performance Test on Kaplan Turbine.
9. Performance Test on Single Stage Centrifugal Pump.
10. Performance Test on Reciprocating Pump.

✓STRENGTH OF MATERIALS

1. Tension test on mild steel rod.
2. Deflection test on Cantilever beam.
3. Deflection test on Simply supported beam
4. Compression test on helical spring.
5. Torsion test on mild steel rod.
6. Impact test on metal specimen.
7. Hardness test on metals.
8. Double shear test on metals

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P821 ELECTRICAL AND ELECTRONICS LAB	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

Any of the 10 Experiments are required to be conducted

LIST OF EXPERIMENTS

1. Brake Test on 3-Ph Squirrel Cage Induction Motor
2. Regulation of 3-Ph Alternator by Synchronous Impedance Method
3. O.C &S.C tests on 1-phase transformer
4. Separation of core losses of 1-phase transformer
5. Load Test on 1-phase Transformer
6. Mesh Analysis
7. Nodal Analysis
8. RL & RC Series circuits
9. Diode characteristics
10. Transistor characteristics

ADDITIONAL EXPERIMENTS

11. CE Amplifier
12. Half wave & Full wave rectifiers

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T108 AERODYNAMICS - I	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Potential Flow: Introduction, Laplace's Equation, Basic flows – Uniform parallel flow, Source, Sink, Simple Vortex, Source-Sink Pair, Doublet, Combination of Simple flows-Flow past a half body, Rankine Ovel, Flow past a circular cylinder without circulation and with circulation, Circulation and lift (Kutta-Joukowsky Theorem)

UNIT - II

Conformal Mapping: Introduction, Basic Principles, Length Ratios between the Corresponding Elements in the Physical and Transformed Planes, Velocity Ratios between the Corresponding Elements in the Physical and Transformed Planes, Methods for Performing Transformation, Kutta-Joukowski Transformation, Transformation of Circle to Straight Line, Transformation of Circle to Ellipse, Transformation of Circle to Symmetrical Aerofoil, Transformation of Circle to Cambered Aerofoil

UNIT - III

Aerofoil Theory: Introduction, Aerofoil Characteristics, The Kutta condition, Thin aerofoil theory and its applications, The flapped aerofoil, The hinge moment coefficient, The normal force and pitching moment derivatives due to pitching, Basics of Panel Method

UNIT - IV

Finite Wing Theory: Introduction, Starting Vortex, Trailing Vortex- Horse shoe vortex,Vortex filament, Biot-Savart law and Helmholtz Theorms, Vortex line, down wash, induced drag, Prandtl's Lifting Line Theory-Elliptic Lift Distribution, General Lift Distribution

UNIT - V

Boundary Layer: Introduction, Boundary layer development, Boundary layer thickness, Displacement thickness, Momentum thickness, Energy thickness, Types of boundary layer, Momentum Integral Estimates- Karman Analysis of the Flat plate, Navier-Stokes Equations, Boundary layer Equaltions-2D Flow, Boundary layer growth on a flat plate-Blasius Solution, Boundary Layer with Pressure Gradient

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TEXT BOOK

Anderson, J.D., "Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York, 1998.

REFERENCES

1. Houghton, E.L., and Carruthers, N.B., "Aerodynamics for Engineering students", Edward Arnold Publishers Ltd., London, 1989.
2. Milne Thomson, L.H., "Theoretical aerodynamics", Macmillan, 1985.
3. Clancey, L.J., "Aerodynamics", Pitman, 1986
4. Fluid Mechanics-E. Rathakrishnan- Third Edition, PHI, 2012

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LBRCE EXAMINATION SECTION

T111 AIRCRAFT STRUCTURES - I	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Failure Theory: Maximum Stress theory – Maximum Strain theory – Maximum Shear Stress Theory –Distortion energy theory – Maximum Strain energy theory, Concept of principal planes- Principal stresses- Determination of normal and tangential stresses-Graphical method- Mohr's circle.

UNIT - II

Statically Determinate Structures: Analysis of plane truss- Method of joints- Method of sections- Plane frames-Composite beam.

UNIT - III

Statically Indeterminate Structures: Propped cantilever- Fixed-Fixed beams- Clapeyron's three moment equation – Moment distribution Method.

UNIT - IV

Energy Methods: Strain Energy due to axial, bending and Torsional loads – Castigliano's theorems-Maxwell's Reciprocal theorem, Unit load method - application to beams and trusses.

UNIT - V

Columns: Introduction- Axially loaded compression members-Crushing load-Buckling load-Euler's theory-Effective length of column- limitations-Euler's formula-Rankine's formula –Column with initial curvature- Columns subjected to eccentric loading – Euler's method- Rankine's method.

TEXT BOOKS:

1. Donaldson, B.K., "Analysis of Aircraft Structures – An Introduction", McGraw-Hill, 1993.
2. Bruhn.E.F."Analysis and design of flight vehicle structures" Tri set of offset Company, USA, 1973.

REFERENCES

1. Timoshenko, S., "Strength of Materials", Vol. I and II, Princeton D. Von Nostrand Co, 1990.
2. B.C.Punmia, "Theory of Structures", Laxmi Publication.
3. S.Ramamrutham, R.Narayanan, "Theory of Structures" – Dhanpat Rai Publishing Co, 2003.

LBRCE EXAMINATION SECTION

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T121 APPLIED THERMODYNAMICS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

VAPOUR POWER CYCLES: Introduction- Carnot vapour power cycle-Rankine Cycle-Comparision between Carnot & Rankine Cycles-Irreversibilities and losses in vapour power cycle-Effect of operating Variables on Rankine Cycle-Reheating of steam-Supercritical Rankine Cycle-Regenerative Rankine Cycle.
STEAM GENERATORS: Boiler Systems- Fire tube Boilers- Water tube boilers-Comparision-High Pressure boilers, Boiler draught-Natural,or Chimney,Draught-Artificial draught-Performance evolution of boilers.

UNIT - II

STEAM NOZZLES: Types of steam nozzles-steam flow through a nozzle-Flow through actual nozzles-Supersaturated expansion of steam.
STEAM CONDENSERS: Introduction-Function of a condenser-Elements of a condensing Plant-Types of Condensers-Jet Condensers-Surface Condensers-Condenser Efficiency.

UNIT - III

STEAM TURBINES: Introduction-Working Principle of a steam turbine-Classification-The Simple Impulse Turbine-Optimum Operating Conditions from blade velocity diagram-Effect of blade friction on velocity diagram-Condition for axial discharge-Compounding of Impulse Turbine-Reaction Turbine-Comparison between Impulse and Reaction Turbines-Losses in Steam Turbines.

UNIT - IV

I.C Engines: Classification-Components-S.I and C.I engines-Comparison –Four Stroke and Two stroke Engines-Comparision-Air-fuel mixure-Carburetion-Simple Carburettor-Fuel Injection System in C.I engines-Engine cooling Systems-Types-Engine Lubrication System-Performance of I.C engines-Simple Problems

UNIT - V

Refrigeration: Introduction-Refrigerators-Unit of Refrigeration-Types of Refrigeration Systems-Air Refrigeration System-Simple air cooling System-Simple air evaporative cooling system-Boot-Strap air evaporative cooling system-Reduced ambient air cooling system-Regenerative air cooling system.
Air Conditioning: Introduction-Psychrometry -Types of air conditioning systems - Summer air conditioning-Winter air-conditioning-Year round air-conditioning (Qualitative treatment).

TEXT BOOK

Applied Thermodynamics, T.D Eastop and A. McConkey, Pearson Education

LBRCE EXAMINATION SECTION

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REFERENCES

1. Basic Engineering Thermodynamics, Rayner Joel, Fifth Edition, AWL
2. Thermal Engineering, Mahesh Rathore, TMH
3. Basic Engineering Thermodynamics, Roy Choudhury
4. Power Plant Engineering, P.K Nag, TMH

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LBRCE EXAMINATION SECTION

T361 MANUFACTURING TECHNOLOGY	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	4	25	75	100

UNIT - I

Introduction to Manufacturing : Historical perspective; Importance of manufacturing; Classification of manufacturing processes; Engineering materials.
Casting: Steps involved in making a casting- Advantages of castings and its applications – Pattern making- Types of patterns- Materials used for patterns- pattern allowances and their constructions-principles of Gating, Gating ratio, types of raisers, casting defects
Special casting processes: 1.Centrifugal 2.Die 3. Investment 4. Continuous

UNIT - II

Welding and other joining processes: Classification of welding process- Types of weld- welded joints and their characteristics- Principle and applications- Gas welding- Arc welding- welding defects; Inert gas welding- Tig and Mig welding; Friction welding, Induction welding, Soldering and Brazing.

UNIT - III

Metal forming processes: Rolling fundamentals- Theory of rolling, types of rolling mills and products; Principles of Forging - Tools and dies – Types of Forging-Smith forging, Drop forging-Drawing and its types- Wire drawing and Tube drawing-Coining- Hot and Cold Spinning.
Extrusion of metals: Basic extrusion process and its characteristics, Hot extrusion and Cold extrusion –Forward extrusion and Backward extrusion, Impact extrusion, Hydrostatic extrusion.
Sheet metal operations: Stamping, Forming and other cold working processes, Blanking and piercing, Bending and forming

UNIT - IV

Machining Processes: Mechanism of chip formation; Tool geometry; cutting tool & tool wear- cutting materials; tool life & mechinability - cutting fluids; Introduction to Lathe- working Principle of lathe and operations

UNIT - V

Machining operations: Shaping, planning, milling, drilling, grinding processes, Finishing processes Introduction to unconventional machining processes: EDM,ECM,UCM,CHM and LBB

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TEXT BOOK

1. Manufacturing science-Amitabha Ghosh, Ashok kumar Malik
2. Manufacturing processes: Serope Kalpakjain, Steven R. Schmid

REFERENCES

1. Manufacturing Technology / P.N. Rao/TMH
2. Production Technology / R.K. Jain
3. Process and materials of manufacturing –Lindberg/PE
4. Production Technology /Sarma P C /
5. Workshop Technology-B.S. Raghuvamsi-Vol.I /PHI

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LBRCE EXAMINATION SECTION

T199 ENVIRONMENTAL STUDIES	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	4	25	75	100

UNIT - I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Need for Public Awareness.

Natural Resources : Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems -Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. **[11 Lectures]**

UNIT – II

Ecosystems : Concept of an ecosystem. - Structure and function of an ecosystem.- Producers, consumers and decomposers. - Energy flow in the ecosystem – Ecological succession. - Food chains, food webs and ecological pyramids.

Biodiversity and its conservation: Introduction - Definition: genetic, species And ecosystem diversity. - Bio-geographical classification of India - Value of Biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. - India as a mega diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

[11 Lectures]

UNIT – III

Environmental Pollution: Definition, Types, Cause, effects and control measures of:

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes. - Role of an individual in prevention of pollution. - Pollution case studies. - Disaster management: floods, earthquake, cyclone and landslides. **[11 Lectures]**

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UNIT – IV

Social Issues and the Environment: From Unsustainable to Sustainable development -Urban problems related to energy -Water conservation, rain water harvesting, watershed management -Resettlement and rehabilitation of people; its problems and concerns. Case Studies -Environmental ethics: Issues and possible solutions. -Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. -Wasteland reclamation. – Consumerism and waste products. **[11 Lectures]**

UNIT – V

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programme -Environment and human health. -Human Rights. -Value Education. HIV/AIDS. -Women and Child Welfare. -Role of information Technology in Environment and human health. –Case Studies. Environment Protection Act. -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act -Issues involved in enforcement of environmental legislation. -Public awareness. **[11 Lectures]**

TEXT BOOKS

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCES

Textbook of Environmental Sciences and Technology by M. Anji Reddy BS Publication.

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LBRCE EXAMINATION SECTION

T285 PROBABILITY AND STATISTICS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Probability: Sample space and events – Probability – The axioms of probability – Some Elementary theorems - Conditional probability – Baye's theorem.

UNIT - II

Random variables – Discrete and continuous distributions - Distribution function. Binomial, Poisson, normal distribution – related properties. Moment generating function, Moments of standard distributions, Evaluation of mean, standard, variance, kurtosis and skewness.

UNIT - III

Population and samples. Sampling distribution of mean (with known and unknown variance), proportion, variances. - Sampling distribution of sums and differences. Point and interval estimators for mean, variance and proportions.

UNIT - IV

Statistical Hypothesis – Errors of Type I and Type II errors and calculation. One tail and two-tailed tests. Testing of hypothesis concerning means, proportions and their differences using Z-test.

Tests of hypothesis using Student's t-test, F-test and χ^2 test. Applications of decision making using the above tests.

UNIT - V

Simple Correlation and Regression.

Queuing Theory: Pure Birth and Death Process M/M/1 Model and Simple Problems related to the evaluation of waiting time, length of the queue etc. ,

TEXT BOOK

Probability and Statistics for Engineers, Miller ,John E. Freund, PHI

REFERENCES

1. Probability and Statistics, Gupta & Kapoor
2. Probability, Statistics and Queuing theory applications for Comp. Sciences, 2/e, Trivedy, John Wiley

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P879 THERMAL ENGINEERING LAB	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

Any of the 10 Experiments are required to be conducted

1. I.C. Engines Valve & Port Timing Diagrams
2. Performance Test on Variable Compression Ratio single cylinder 4-Stroke petrol Engine By using Eddy Current Dynamometer
3. Performance Test on single cylinder 4 -Stroke Diesel Engine by using Mechanical Dynamometer
4. Performance test on twin cylinder 4-stroke diesel engine.
5. Performance Test on single cylinder 2-Stroke Petrol Engine.
6. Evaluation of Engine friction power by conducting Morse test on Multi cylinder 4-Stroke Petrol Engine.
7. Evaluation of Engine friction by conducting Retardation test on 4-stroke Diesel Engine.
8. I.C. Engine Heat Balance.
9. Performance test on PC based diesel Engine test rig.
10. Measurement of pollutants and smoke of I.C Engine.
11. Performance Test on Reciprocating Air – Compressor.
12. Performance Test on Vapour Compression Refrigeration Unit.
13. Performance Test on Air Conditioning Unit.
14. Assembly / Disassembly of Engines.
15. Viscosity of lubricants by using Redwood/ Say bolt viscometer Apparatus
16. Flash and Fire Point of fuels by using pesky Martin Apparatus
17. Carbon Residue test
18. Determination of calorific value of fuel using calorimeter.

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P885 MANUFACTURING TECHNOLOGY LAB	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

I. METAL CASTING LAB

1. Pattern Design and making - for one casting drawing.
2. Sand properties testing - Exercise -for strengths, and permeability – 1
3. Moulding Melting and Casting - 1 Exercise

II WELDING LAB

1. ARC Welding Lap & Butt Joint - 2 Exercises
2. Spot Welding - 1 Exercise
3. TIG Welding - 1 Exercise

III MECHANICAL PRESS WORKING

1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations

IV PROCESSING OF PLASTICS

1. Injection Moulding

V. MACHINE TOOLS LAB

1. Lathe Operations
2. Special Machines – Drilling, Shapping, Milling, Sruface Griding, Sloting
3. Preparation of Single point cutting tool

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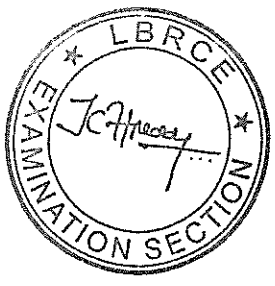
V-SEMESTER



T292 PROPULSION-I	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Fundamentals of Gas Turbine Engine: Working of gas turbine engine – The thrust equation – Factors affecting thrust – Effect of pressure, velocity and temperature changes of air entering compressor – Methods of thrust augmentation – Characteristics of turboprop, turbofan and turbojet – Performance characteristics.

UNIT - II

Subsonic and supersonic inlets: Introduction, Subsonic Inlets, internal flows, external flow, Supersonic inlets – Starting problem on supersonic inlets, Shock-Swallowing, Flow stability problem

UNIT - III

Compressors: Principle of operation of centrifugal compressor – Work done and pressure rise – Velocity diagrams – Diffuser vane design considerations – Concept of Prewhirl, Stall and Surge, Elementary theory of axial flow compressor – Velocity triangles – degree of reaction – Three dimensional Analysis– Air angle distributions for free vortex and constant reaction designs – Compressor blade design – Centrifugal and Axial compressor performance characteristics.

UNIT - IV

Combustion Chambers
Classification of combustion chambers – Important factors affecting combustion chamber design – Combustion process – Combustion chamber performance – Effect of operating variables on performance – Flame tube cooling – Flame stabilization – Use of flame holders, Fuel Injection System

UNIT - V

Axial Flow Turbines: Impulse and reaction turbines – Velocity triangles and power output – Elementary theory – Vortex theory – Choice of blade profile, pitch and chord – Estimation of stage performance – Limiting factors in gas turbine design- Overall turbine performance – Methods of blade cooling – Matching of turbine and compressor, The radial flow turbine

TEXT BOOK

Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison – Wesley Longman INC, 1999.

LBRCE EXAMINATION SECTION

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REFERENCES

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "Gas Turbine Theory", Longman, 1989.
2. Oates, G.C., "Aero thermodynamics of Aircraft Engine Components", AIAA Education Series, New York, 1985.
3. "Rolls Royce Jet Engine" – Third Edition – 1983.
4. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 1999.

LBRCE EXAMINATION SECTION

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T347 AERODYNAMICS – II	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Basics of Compressible Flow: Introduction, Compressibility, Basic Equations of compressible flow- Energy equation, Isentropic flow relations, Stagnation Properties, Speed of sound, Mach Number, Mach angle, Mach cone, Mach wave, Shock wave, Wave propagation

UNIT - II

Steady One-dimensional Flow: Introduction, Fundamental Equations, Discharge from a reservoir, Critical values, Stream tube area-velocity relation, Types of nozzles, Applications of nozzles, Area-Mach number relation, Isentropic flow through nozzles, Diffusers, Dynamics head measurement in compressible flow, Compressibility correction to dynamics pressure, Pressure coefficient

UNIT - III

Shock and Expansion Waves: Introduction, Types of waves, Normal shock- equations of motion, The normal shock relations for perfect gas, Hugoniot equation, Oblique shocks- Relation between β-θ-M, Shock Polar, Detached Shocks, Expansion waves, Prandtl-Meyer Flow, Simple and Nonsimple Regions, Flow with shocks and expansion waves at the exit of a convergent- divergent nozzle, Method of Characteristics

UNIT - IV

Flow with Friction and Heat Transfer: Introduction, Flow in constant Area Duct with friction, Adiabatic Constant area flow of a perfect gas, Fanno line Flow, Flow with heating and cooling in ducts,Rayleigh line relation.

UNIT - V

Compressible Flow over Wings: Introduction, Crocco's Therorem, Potential Equation for Compressible flow, Linearization of Potential Equation, Prandtl-Glauert Rule, Critical Mach Number, Drag-Divergence Mach Number, Area-Rule, Supercritical Aerofoil, Forward Swept and Swept Back Wings, Delta Wings

TEXT BOOK

Gas Dynamics, E. Rathakrishnan, Third Edition, Prentice Hall of India pvt. Ltd, New Delhi, 2010

LBRCE EXAMINATION SECTION

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REFERENCES

1. The dynamics and thermodynamics of compressible fluid flow Vol I by Ascher H. Shapiro, The Ronald press Co. New York, 1953
2. Elements of Gas Dynamics, H.W. Lipmann and A. Roshko
3. Compressible Fluid Dynamics, Thomson P.A ,McGraw-Hill, New York, 1972
4. Anderson, J.D., "Fundamentals of Aerodynamics", McGraw-Hill Book Co., New York, 1998.

LBRCE EXAMINATION SECTION

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T113 AIRCRAFT SYSTEMS AND INSTRUMENTS	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	4	25	75	100

UNIT - I

AIRPLANE CONTROL SYSTEMS

Conventional Systems – Power assisted and fully powered flight controls – Power actuated systems – Engine control systems – Push pull rod system – operating principles – Modern control systems – Digital fly by wire systems – Auto pilot system, Active Control Technology

UNIT - II

AIRCRAFT SYSTEMS

Hydraulic systems - Study of typical workable system - components – Pneumatic systems - Advantages - Working principles - Typical Air pressure system – Brake system - Typical Pneumatic power system - Components, Landing Gear systems - Classification

UNIT - III

ENGINE SYSTEMS

Fuel systems for Piston and jet engines, - Components of multi engines. Lubricating systems for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet engines

UNIT - IV

AUXILIARY SYSTEM

Basic Air Cycle systems – Vapour Cycle Systems, Boot-strap air cycle system – Evaporative vapour cycle systems – Evaporation air cycle systems – Oxygen systems – Fire protection systems, Deicing and anti icing system.

UNIT - V

AIRCRAFT INSTRUMENTS

Flight Instruments and Navigation Instruments – Accelerometers, Air speed Indicators – Mach Meters – Altimeters - Gyroscopic Instruments– Principles and operation – Study of various types of engine instruments – Tachometers – Temperature gauges – Pressure gauge – Operation and principles.

LBRCE EXAMINATION SECTION

TEXT BOOKS

1. McKinley, J.L., and Bent, R.D., "Aircraft Maintenance & Repair", McGraw-Hill, 1993.
2. "General Hand Books of Airframe and Powerplant Mechanics", U.S. Dept. of Transportation, Federal Aviation Administation, The English Book Store, New Delhi1995.

REFERENCES

1. Mekinley, J.L. and Bent, R.D., "Aircraft Power Plants", McGraw-Hill, 1993.
2. Pallet, E.H.J., "Aircraft Instruments & Principles", Pitman & Co., 1993.
3. Treager, S., "Gas Turbine Technology", McGraw-Hill, 1997.

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LBRCE EXAMINATION SECTION

T211 HEAT TRANSFER	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Introduction: Basic Modes of Heat Transfer- Basic laws of Heat transfer- Applications of heat transfer- Steady, Unsteady and Periodic Heat Transfer- Heat conduction-Fourier equation-Thermal conductivity-General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates and its simplification-Initial and boundary conditions.

One- Dimensional Steady State Conduction: Heat flow through plane wall and cylinder with constant thermal conductivity- Electrical analogy-Thermal resistance-Overall heat transfer coefficient-Heat flow through Composite Wall and Cylinder - Critical radius of insulation for Cylinder.

UNIT - II

One Dimensional Steady State Conduction: Heat flow through plane wall and cylinder with Variable Thermal conductivity - Uniform internal heat generation in Slabs-Extended Surfaces- Analysis of Long Fin and Short fin with insulated tip - Fin efficiency and Effectiveness .

One Dimensional Transient Heat Conduction: Systems with negligible internal resistance-Lumped Heat analysis–Significance of Biot and Fourier Numbers-Plane wall with finite surface and internal resistance using Heisler Chart.

UNIT - III

Convective Heat Transfer: Introduction-Types of Convection- Convective heat transfer coefficient- Dimensional analysis -Buckingham Pi Theorem applied to Forced convection --Significance of Non Dimensional numbers-The boundary layer concept-The velocity and Thermal boundary layers.

Forced Convection: External Flow-Laminar and Turbulent Flow over a Flat plate – Internal Flow through Circular pipe-Laminar and Turbulent Flows-Entry length and Fully developed flow - Reynolds Colburn analogy

Natural Convection: Development of Hydrodynamic and thermal boundary layer along a Vertical plate- Empirical correlations for Vertical plate , Vertical Cylinder, Horizontal Plate and Horizontal Cylinder.

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UNIT - IV

Boiling and Condensation: Boiling Heat transfer phenomena- Pool Boiling- Boiling regimes- Critical Heat Flux-Condensation-Film wise and Drop wise condensation-Laminar film wise condensation on Vertical plate.
Thermal Radiation: Introduction-Nature of Thermal radiation-Emissive power-Absorption, Reflection and Transmission-Concept of Black body –Laws of Black Body Radiation- Radiation from Non black surfaces-Emissivity-Kirchhoff's law - Radiation heat exchange between two black isothermal surfaces- shape factor- Heat exchange between non black infinite parallel plates- Radiation shields

UNIT - V

Heat Exchangers: Introduction-Classification of heat exchangers -Flow arrangement, Temperature distribution- Overall heat transfer coefficient- Fouling factor- LMTD method of Heat exchanger analysis-Correction for LMTD for use with multi pass and cross flow Heat Exchangers, Effectiveness - NTU method of Heat Exchanger analysis.
NOTE: Heat and Mass Transfer Data Book by C.P. Kothandaraman and Subramanian- New Age Publications is to be allowed in Examination.

TEXT BOOK

Fundamentals of Engineering Heat and Mass Transfer – R.C. Sachdeva –New Age Intl. Publishers 2nd Edn., 2005

REFERENCES

1. Elements of Heat transfer-Ethirajan Rathakrishnan- CRC press, New York
2. Heat and Mass Transfer- A Basic Approach—Necati Ozisik –McGrawHill
2. Heat Trasnfer – C. J. Cengel - TMH
3. Heat transfer - J.P.Holman, McGrawHill
4. Heat and Mass Transfer- P.K. Nag –TMH 2nd Edn., 2007
5. Heat Transfer by P.S Ghoshdastidar- Oxford University Press.

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LBRCE EXAMINATION SECTION

T132 CAD/CAM	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	4	25	75	100

UNIT - I

Fundamentals of CAD: Introduction – The design process – The application of computers for design- Creating the manufacturing data base – Benefits of CAD.
Computer Graphics: Introduction – Software configuration of graphics system – Functions of a Graphics package – Transformations: Translation, scaling, reflection, rotation, Concatenated transformation.

UNIT - II

Geometric Modeling: **Representation of curves**: Introduction, wireframe models, wireframe entities, curve representation, parametric representation of analytical curves, parametric representation of Bezier and B-Spline curves
Representation of surfaces: Introduction, surface models surface entities, parametric representation of analytical surfaces- parametric representation of Bezier and B-Spline surfaces
Representation of solids: Introduction, solid models, solid entities, Solid representation, Fundamentals of solid modeling, Boundary representation, CSG representation.

UNIT - III

Computer Numerical Control: Introduction – NC modes – NC elements -NC Coordinate systems – Structure of CNC Machine Tools – Spindle design –Spindle drives – Feed drives – actuation systems.
Part Programming: Part programming Fundamentals – Manual part programming-computer aided part programming: APT Language.

UNIT - IV

Group Technology: Introduction – part families – parts classifications and cooling – OPITZ system – MICLASS system – CODE system – GT Machine cells – Benefits of GT – CAPP: Retrieval type and generative type
Flexible Manufacturing system: Introduction – FMS components – Benefits of FMS – FMS planning and implementation Issues.

UNIT - V

Computer Aided Quality Control: Introduction – the computers in Q C – Contact Inspection methods – Non contact inspection methods: optical, non optical – Computer Aided Testing-Integration of CAQC with CAD/CAM.
Computer Integrated Manufacturing Systems: Introduction – Integration- CIM implementation – Benefits of CIM – Lean manufacturing.

L B R E EXAMINATION SECTION

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TEXT BOOK

Ibrahim Zeid, CAD/CAM theory and practice, TATA MC Graw Hill publishing CO.Ltd, New Delhi.

REFERENCES

1. Mikell P.Groover and Emory W.Zimmers, CAD/CAM- prentice Hall of India private LTD. New Delhi
2. PN Rao, CAD/CAM Principle and Applications, Tata MC Graw Hill Education Private Ltd, New Delhi.
3. P.Radhakrishnan, S.Subramanyan &V.Raju, CAD/CAM/CIM, New Age International Publishers

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LBRCE EXAMINATION SECTION

T250 METALLURGY AND MATERIAL SCIENCE	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	4	25	75	100

UNIT - I

Structure of Metals: Bonds in Solids – Ionic bond, covalent bond and metallic bond - Mechanism of crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size.
Constitution of Alloys: Necessity of alloying, Solid solutions-Interstitial Solid Solution and Substitutional Solid Solution, Hume Rotherys rules.

UNIT - II

Equilibrium Diagrams: Experimental methods of construction of equilibrium diagrams, Classification of equilibrium diagrams- isomorphous, eutectic, partial eutectic equilibrium diagrams. Equilibrium cooling and heating of alloys, lever rule, coring. Transformations in the solid state – allotropy, eutectic, eutectoid, peritectoid reactions. Study of Cu-Ni and Fe-Fe_3C equilibrium diagrams.

UNIT - III

Steels: Classification of steels, structure and properties of plain carbon steels-low carbon steel, medium carbon steel and high carbon steel.
Cast Irons: Structure and properties of white cast iron, malleable cast iron, grey cast iron, spheroidal graphite cast iron.
Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminium and its alloys.

UNIT - IV

Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth. Comparison of properties of cold and hot worked parts.
Heat treatment of Alloys: Annealing, normalizing and hardening. Construction of TTT diagram for eutectoid steel. Hardenability-determination of hardenability by jominy end quench test. Surface - hardening methods and age hardening treatment.

UNIT - V

Ceramic Materials: Properties and applications of ceramic materials, glasses, cermets, and abrasive materials
Composite Materials: Classification of composites, various methods of component manufacture of fiber reinforced composites-hand layup process, filament winding process, SMC processes, continuous pultrusion processes, resin transfer moulding.
Introduction to metal ceramic mixtures, metal – matrix composites and C – C composites.

TEXT BOOK

Introduction to Physical Metallurgy / Sidney H. Avener-Tata McGraw-Hill

REFERENCES

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1. Engineering Materials and Their Applications/Richard A.Flinn, Paul K.Trojan-Jaico Publishing House.
2. Material Science and Metallurgy/kodgire- Everest Publishing House.
3. Science of Engineering Materials / Agarwal
4. Materials Science and engineering / William and collister.

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LBRCE EXAMINATION SECTION

P803 AERODYNAMICS LAB	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

Any of the 10 Experiments are required to be conducted

1. Calibration of a Subsonic Wind Tunnel
2. Determination of Lift for the given aerofoil section
3. Pressure Distribution over a smooth circular cylinder
4. Pressure Distribution over a rough circular cylinder
5. Pressure Distribution over a symmetrical aerofoil
6. Pressure Distribution over a cambered aerofoil
7. Flow visualization study over objects in water flow channel
8. Generation of potential flow pattern over objects using Hele-Shaw Apparatus
9. Flow visualization in smoke tunnel
10. Calibration the Open Jet Facility
11. Design and Calibration of Convergent- Divergent Nozzle
12. Estimation of Mach Number of Convergent and Convergent- Divergent Nozzle
13. Studies on overexpanded, correctly expanded and underexpanded flows
14. Yaw effect on Pitot probe and Pitot-Static probe in incompressible flows
15. Yaw effect on Pitot probe and Pitot-Static probe in compressible flows
16. Studies on Suddenly Expanded Flows
17. Subsonic Jet Characteristics
18. Supersonic Jet Characteristics
19. Supersonic Flow Visualization using Shadowgraph Technique

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LBRCE EXAMINATION SECTION

P836 HEAT TRANSFER LAB	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

Any of the 10 Experiments are required to be conducted

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzmann Apparatus.
12. Heat transfer in drop and film wise condensation.
13. Critical Heat flux apparatus.
14. Study of heat pipe and its demonstration.
15. Study of Two – Phase flow.

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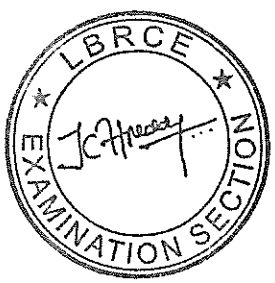
VI-SEMESTER



T355 FLIGHT DYNAMICS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

STEADY FLIGHT PERFORMANCE: Equations of motion of a airplane in flight , Thrust to Weight Ratio, Wing Loading, Drag polar, and Lift to Drag Ratio, Thrust Required for level and Unaccelerated Flight, Thrust Available and maximum Velocity, Power Required for level and Unaccelerated Flight, Power Available and Maximum Velocity, Altitude Effects, Drag Divergence

UNIT - II

MANOEUVERING FLIGHT PERFORMANCE: Rate of Climb, Time to Climb, Range, Endurance, Gliding flight, Absolute and Service Ceilings, Take-off and landing Performance, Turning Flight and V-n diagram, Accelerated Flight of Climb (Energy Method),

UNIT - III

STATIC LONGITUDINAL STABILITY AND CONTROL: Introduction, Moments on the airplane, Absolute Angle of Attack, Criteria for Longitudinal Static Stability, Neutral Point, Static Margin, Stick fixed and Stick free stability, Elevator Hing Moment, Stick-free Longitudinal Static Stability, Power Effects

UNIT - IV

LATERAL AND DIRECTIONAL STATIC STABILITY: Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock, Power Effects

UNIT - V

DYNAMIC STABILITY AND CONTROL: Introduction to dynamic longitudinal stability: - Modes of stability, Routh's Discriminant, effect of freeing the stick, Phigoid Motion, Brief description of lateral and directional dynamic stability- Spiral, divergence, Dutch roll, auto rotation and spin

TEXT BOOKS

1. Aircraft Performance and Design, J.D Anderson, Tata McGrawhill Edition
2. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son:, Inc, NY, 1988.

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REFERENCES

1. Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 2004.
2. Etkin, B., "Dynamics of Flight Stability and Control", Edn. 2, John Wiley, NY, 1982.
3. Babister, A.W., "Aircraft Dynamic Stability and Response", Pergamon Press, Oxford, 1980.
4. Dommasch, D.O., Sherby, S.S., and Connolly, T.F., "Aeroplane Aero dynamics", Third Edition, Issac Pitman, London, 1981.
5. Mc Cornick B. W, "Aerodynamics, Aeronautics and Flight Mechanics", John Wiley, NY, 1995.

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LBRCE EXAMINATION SECTION

T112 AIRCRAFT STRUCTURES - II	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

UNSYMMETRICAL BENDING: General, Principal axis and neutral axis methods- bending stresses in beams of symmetric sections with skew loads- bending stresses in beams of unsymmetrical sections.

UNIT - II

SHEAR FLOW IN OPEN SECTIONS: Thin walled beams, Concept of shear flow, shear centre, Elastic axis. With one axis of symmetry, with wall effective and ineffective in bending, unsymmetrical beam sections.

UNIT - III

SHEAR FLOW IN CLOSED SECTIONS: Bredt – Batho formula, Single and multi – cell structures.- Shear flow in single & multicell structures under torsion. Shear flow in single and multicell under bending with walls effective and ineffective.

UNIT - IV

BUCKLING OF PLATES: Rectangular sheets under compression, local buckling stress of thin walled section- Crippling stresses by Needham's and Gerard's methods, Thin walled column strength sheet stiffener panels-Effective width.

UNIT - V

STRESS ANALYSIS IN WING AND FUSELAGE: Shear resistant web beams- Tension field web beams(Wagner's) – Shear and bending moment distribution for cantilever and semi-cantilever types of beams-loads on aircraft – lift distribution-V-n diagram-Gust loads

TEXT BOOKS

1. Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw–Hill, N.Y., 2007.
2. Megson, T.M.G., "Aircraft Structures for Engineering Students", Edward Arnold, 2007.

REFERENCES

1. Bruhn. E.H. "Analysis and Design of Flight vehicles Structures", Tri – state off set company, USA, 1985.
2. Rivello, R.M., "Theory and Analysis of Flight Structures", McGraw-Hill, 1993.

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T293 PROPULSION - II	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

RAMJET PROPULSION: Operating principle – Sub critical, critical and supercritical operation – Combustion in ramjet engine – Ramjet performance – Sample ramjet design calculations, Need of Supersonic Combustion, Components and Working principle of Supersonic Ramjet Engine, Isolators, Types of Combustion Chambers for Scramjet Engine, Operating Envelop of Ramjet Engine, Mixing Process in SCRAMJET Combustion

UNIT - II

ROCKET PROPULSION: Operating principle, Effective Exhaust Velocity and Specific impulse, Rocket Propulsion Requirements, Equations of Motion for an Accelerating Rocket, Multistage Rocket

UNIT - III

LIQUID PROPELLANT ROCKET: Introduction, Liquid Propellants, Propellant Feed Systems-Gas pressure feed systems, Types of Fuels and Oxidizers, Combustion Process, Combustion Instability, Propellant Tanks, Tank pressurization, Maneuvering, Orbit Adjustment, Attitude control

UNIT - IV

SOLID PROPELLANT ROCKET: Solid propellant rockets, Combustion process, Propellant Burning Rate, Selection criteria of solid propellants, Propellant grain and its configuration, Hybrid Rockets, Propellant Grain Stress and Strain, Attitude Control Rocket Motor

UNIT - V

ADVANCED PROPULSION TECHNIQUES: Electric rocket propulsion-Electrothermal, Non-Electrothermal, Electrostatic Electro Magnetic Thrusters, Ion propulsion techniques, Arcjet, Pulsed Magnetoplasma Accelerators, Solar sail, Nozzleless propulsion, Energy Spike, MHD Propulsion, Nuclear rockets

TEXT BOOK

Sutton, G.P., "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edn., 1993.

LBRCE EXAMINATION SECTION

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REFERENCES

1. Elements of propulsion: Gas Turbines and Rockets, J.D Mattingly, AIAA Educational Series
2. Cohen, H., Rogers, G.F.C. and Saravanamuttoo, H.I.H., "Gas Turbine Theory", Longman Co., ELBS Ed., 1989.
3. Hill, P.G. & Peterson, C.R. "Mechanics & Thermodynamics of Propulsion" Addison – Wesley Longman INC, 1999.
4. Gorden, C.V., "Aero thermodynamics of Gas Turbine and Rocket Propulsion", AIAA Education Series, New York, 1989.
5. Mathur, M., and Sharma, R.P., "Gas Turbines and Jet and Rocket propulsion",StandardPublishers, New Delhi, 1988.

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LBRCE EXAMINATION SECTION

T203 FINITE ELEMENT METHOD	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Introduction to Finite Element Method for solving field problems - Stress and Equilibrium - Strain – Displacement relations- Stress – strain relations One Dimensional problem: Finite element modeling coordinates and shape functions- Pascal triangle –Pascal pyramid- Potential Energy approach - Assembly of Global stiffness matrix and load vector-Finite element equations- Treatment of boundary conditions

UNIT - II

Analysis of Beams: Element stiffness matrix for two nodes, two degrees of freedom per node beam element Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions.

UNIT - III

Finite element modeling of axisymmetric solids subjected to axisymmetric loading with triangular elements. Two dimensional four noded isoparametric elements and numerical integration-Gauss quadrature

UNIT - IV

One dimensional steady state heat transfer analysis of a fin-Element conductivity matrix-Convection matrix-Heat rate vector. Two dimensional analysis of thin plate with triangular elements-Element conductivity matrix-Convection matrix-Heat rate vector

UNIT - V

Dynamic Analysis: Formulation of finite element model-element matrices-evaluation of eigen values and eigen vectors for a stepped bar and a beam.

TEXT BOOK

Introduction to Finite Elements in Engineering / Chandraputla, Ashok and Belegundu / Prentice – Hall

REFERENCES

1. An introduction to Finite Element Method / JN Reddy / Me Graw Hill
2. The Finite Element Methods in Engineering / SS Rao / Pergamon
3. The Finite Element Method for Engineers – Kenneth H. Huebner, Donald L. Dewhirst, Douglas E Smith and Ted G. Byrom/John Wiley & sons(ASIA)Pte. Ltd.
4. Finite Element Analysis/ C.S.Krishna Murthy

LBRCE EXAMINATION SECTION

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T325 THEORY OF MACHINES	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

MECHANISMS: Machine- Structure – Kinematic link, pair and chain – Grueblers criteria – Constrained motion – Degrees of freedom – Four bar mechanism - Sinle and Double slider crank chains – Inversions – Applications – Kinematic analysis of simple mechanisms – Determination of velocity and acceleration of four bar and single slider crank mechanism only.

UNIT - II

FRICTION: Friction in screw and nut – Pivot and collar – Thrust bearing – Plate and disc clutches – Belt (flat and V) and rope drives. Ratio of tensions – Effect of centrifugal and initial tension – Condition for maximum power transmission – Open and crossed belt drive.

UNIT - III

GEARING AND CAMS: Gear profile and geometry – Nomenclature of spur and helical gears only– Gear trains - Simple, compound gear trains and epicylic gear trains - Determination of speed and torque Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions

UNIT - IV

PRECISSION: Effect of Precission on Stability of moving vehicles such as motorcar motorcycle Aero planes- Static and Dynamic forces generated due to in Precission in moving mechanisms including Gyroscopic motions..

UNIT-V

BALANCING: Static and dynamic balancing – Single and several masses in different planes –Balancing of reciprocating masses- primary balancing and concepts of secondary balancing – Single and multi cylinder engines (Inline) – Balancing of radial V engine – direct and reverse crank method.

TEXT BOOKS

1. Rattan.S.S, "Theory of Machines", Tata McGraw–Hill Publishing Co, New Delhi,2004.
2. Ballaney.P.L, "Theory of Machines", Khanna Publishers, New Delhi, 2002.

LBRCE EXAMINATION SECTION

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REFERENCES

1. Rao, J.S and Dukkipati, R.V, "Mechanism and Machine Theory", Second Edition, Wiley Eastern Ltd., 1992.
2. Malhotra, D.R and Gupta, H.C., "The Theory of Machines", Satya Prakasam, Tech. India Publications, 1989.
3. Gosh, A. and Mallick, A.K., "Theory of Machines and Mechanisms", Affiliated East West Press, 1989.
4. Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw-Hill, 1980.
5. Burton Paul, "Kinematics and Dynamic of Planer Machinery", Prentice Hall, 1979.

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LBRCE EXAMINATION SECTION

T350 APPLIED GAS DYNAMICS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

TWO-DIMENSIONAL COMPRESSIBLE FLOWS: Introduction, General Linear Solution for Supersonic Flow-Existence of Characteristics in a Physical Problem, Equation for the streamlines from Kinematic Flow Condition, Flow over Wave shaped Wall

UNIT - II

METHOD OF CHARACTERISTICS: Introduction, Concept of Characteristics, Compatibility Relation, Numerical Computational Method, Theorems for Two Dimensional Flow, Numerical Computation with Weak Finite Waves, Design of Supersonic Nozzle-Contour Design Details

UNIT - III

HYPERSONIC TUNNEL: Hypersonic Tunnel Circuit, Hypersonic Nozzle, Calibration of Hypersonic Tunnels, Determination of Mach Number, Flow Angularity, Turbulence Level, Reynolds number Effects, Force Measurement

UNIT - IV

RAREFIED GAS DYNAMICS: Introduction, Molecular Model of Gases, Mean Free path of Molecules, Knudsen Number, Flow Regimes, Boltzmann's Relation, Basic Concepts of Kinetic Theory, Slip Flow, Transition and Free Molecular Flow

UNIT - V

JETS: Introduction, Classification of Jets, Different Zones of Subsonic Jet, Mathematical Treatment of jet Profile, Turbulence Characteristics of Free Jets, Supersonic Jet-Correction Expansion, Over Expansion, Underexpansion, Experimental Methods for Studying Jets-JetTest Facility, Mixing Mechanism, Jet Control Techniques, Jet Noise

REFERENCES

1. Applied Gas Dynamics, E. Rathakrishnan, John Wiley and Sons PVT. Ltd, 2010
2. Gas Dynamics, E. Rathakrishnan, Third Edition, Prentice Hall of India pvt. Ltd, New Delhi, 2010
3. The dynamics and thermodynamics of compressible fluid flow Vol I by Ascher H. Shapiro, The Ronald press Co. New York, 1953
4. Elements of Gas Dynamics, H.W. Lipmann and A. Roshko
5. Compressible Fluid Dynamics, Thomson P.A ,McGraw-Hill, New York, 1972
6. Rarefied Gas Dynamics, Shen, Ching, Springer

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T363 SPACE MECHANICS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

BASIC CONCEPTS: The Solar System – References Frames and Coordinate Systems – The Celestial Sphere, – The Ecliptic – Motion of Vernal Equinox – Sidereal Time – Solar Time – Standard Time – The Earth's Atmosphere.

UNIT - II

THE GENERAL N-BODY PROBLEM: Lagrange – Jacobian Identity –The Circular Restricted Three Body Problem – Libration Points- Relative Motion in the N-body Problem –Two –Body Problem – Satellite Orbits – Relations Between Position and Time – Orbital Elements.

UNIT - III

SATELLITE INJECTION AND SATELLITE ORBIT PERTURBATIONS: General Aspects of satellite Injections – Satellite Orbit Transfer –Various Cases – Orbit Deviations Due to injection Errors – Special and General Perturbations – Cowell's Method – Encke's Method – Method of vibrations of Orbital Elements – General Perturbations Approach.

UNIT - IV

INTERPLANETARY TRAJECTORIES: Two Dimensional Interplanetary rajectories – Fast Interplanetary Trajectories – Three Dimensional Interplanetary Trajectories – Launch if interplanetary Spacecraft – Trajectory about the Target Planet.

UNIT - V

BALLISTIC MISSILE TRAJECTORIES AND MATERIALS: The Boost Phase – The Ballistic Phase –Trajectory Geometry- Optimal Flights – Time of Flight – Re – entry Phase – The Position of the Impact Point – Influence Coefficients. Space Environment – Peculiarities – Effect of Space Environment on the Selection of Spacecraft Material.

REFERENCES

1. Cornelisse, J.W., "Rocket Propulsion and Space Dynamic", W.H. Freeman & Co., 1984.
2. Sutton, G.P., "Rocket Propulsion Elements", John Wiley, 1993.
3. Van de Kamp, P., "Elements of Astro-mechanics", Pitman, 1979.
4. Parker E.R., "Materials for Missiles and Spacecraft", McGraw-Hill Book Co. Inc.,1982.

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T324 THEORY OF ELASTICITY	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

Elasticity: Two dimensional stress analysis - Plane stress - Plane strain - Equations of compatibility - Stress function - Boundary conditions.
Problem in rectangular coordinates - Solution by polynomials - Saint Venent's principles -Determination of displacement - Simple beam problems.

UNIT - II

Problems in polar coordinates - General equations in polar coordinates - Stress distribution symmetrical about axis - Strain components in polar coordinates - Simple and symmetric problems.

UNIT - III

Analysis of stress and strain in three dimensions - Principle stresses – Homogeneous deformations - Strain spherical and deviatoric stress - Hydrostatic strain.

UNIT - IV

General theorems: Differential equations of equilibrium and compatibility - Displacement - Uniqueness of solution - Reciprocal theorem.

UNIT - V

Bending of prismatic bars - Stress function - Bending of cantilever beam - Beam of rectangular cross-section - Beams of circular cross-section.

REFERENCES

1. Timeshenko & Goodier, Theory of Elasticity - McGraw Hill
2. Theory of Elasticity by A.I.Lurie, Springer
3. Experimental stress analysis by Dally and Riley,Mc Graw-Hill
4. A treatise on Mathematical theory of Elasticity by LOVE .A.H, Dover publications Inc
5. Theory of Elasticity by A.Meceri, Springer
6. Applied Elasticity by W.T. Wang.

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T358 HYPERSONICS AND HIGH ENTHALPY FLOWS	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	3	25	75	100

UNIT - I

FUNDAMENTALS OF HYPERSONIC AERODYNAMICS:
Introduction to hypersonic aerodynamics-differences between hypersonic aerodynamics and supersonic aerodynamics-concept of thin shock layers-hypersonic flight paths-hypersonic similarity parameters-shock wave and expansion wave relations of in viscid hypersonic flows

UNIT - II

INVISCID HYPERSONIC FLOWS: Local surface inclination methods-Newtonian theory-modified Newtonian law-tangent wedge and tangent cone and shock expansion methods-approximate theory-thin shock layer theory.

UNIT - III

VISCOUS HYPERSONIC FLOW: Boundary layer equation for hypersonic flow-hypersonic boundary layers-self similar and non self similar boundary layers-solution methods for non self similar boundary layers, Aerodynamic heating

UNIT - IV

VISCOUS INTERACTIONS IN HYPERSONIC FLOWS: Introduction to the concept of viscous interaction in hypersonic flows-strong and weak viscous interactions-hypersonic viscous interaction similarity parameter-introduction to shock wave boundary layer interactions

UNIT - V

HIGH TEMPERATURE GAS DYNAMICS: Nature of high temperature flows-chemical effects in air-real and perfect gases-Gibb's free energy and entropy-chemically reacting mixtures-recombination and dissociation.

REFERENCES

1. John. D. Anderson. Jr., "Hypersonic and High Temperature Gas Dyanmics", Mc. Graw hill Series, New York, 1996.
2. John. D. Anderson. Jr ., "Modern compressible flow with historical perspective", Mc.
Graw Hill Publishing Company, New York, 1996
3. John. T Bertin, "Hypersonic Aerothermodynamics", published by AIAA Inc.,Washington. D.C., 1994.

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T270 OPTIMIZATION TECHNIQUES	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	3	25	75	100

OBJECTIVE

This course is a basic mathematical tool in solution of number of system operational methods and design of components and systems. The course also contains non-traditional optimization techniques like Genetic Algorithms and Particle Swarm methods. The contents of this course are also widely used in operations research in systems planning and management.

UNIT - I

Linear Programming (LP)
Introduction through engineering applications, standard form of LP problem (LPP), Geometrical interpretation, simplex method and algorithm, two phases of simplex method, Numerical problems, Revised simples method, Duality in LP, Dual simplex method, sensitivity analysis.

UNIT - II

Applications and extensions of LP
Transportation problem, Assignment problem, Karmarkar's method, Quadratic programming and Engineering Applications.

UNIT - III

Non-linear Programming – Unconstrained minimization
Interpolation methods, quadratic and cubic interpolation methods, Newton's method.Gradient Methods – Steepest descent, conjugate gradient, Newton's and quasi Newton methods, Davidon-Flecher-Powell method, numerical problems.

UNIT - IV

Non-linear Programming – Constrained Minimization
Legrangian multipliers, Kuhn-Tucker conditions, sequential LP method, methods of feasible directions, Rosen's gradient projection method, Generalized reduced gradient method, Interior and exterior penalty function methods.

UNIT - V

Dynamic Programming & Non-traditional Optimization
Principle of optimality, computational procedure, applications from engineering. Evolutionary Programming Techniques – Genetic Algorithm (GA), the three parameters of GA, computational procedure for both binary and analogue coded inputs. Introduction to Particle swarm Optimization. Numerical examples.

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TEXT BOOKS

1. "Engineering Optimization – Theory and Practice", S.S. Rao, III Edition, John Wiley & Sons 1996 and New Age International Pvt Ltd., New Delhi, 2002.
2. "Optimization for Engineering Design - Algorithms and Examples", Kalyanmoy Deb, PHI Learning Private Ltd, New Delhi, 1995.

REFERENCES

1. "Optimization Methods in Operations Research and Systems Analysis", K.V. Mittal and C Mohan, II edition 1983, New Age International Publishers, New Delhi.
2. "Combinatorial Optimization – Algorithms and Complexity", Christos H Papadimitriou and Kenneth Steiglitz, Prentice Hall of India 1997.
3. "Introduction to Optimization & Operations Research", J C Pant, IV Edition, Jain Brothers, New Delhi.
4. "Genetic Algorithms in Search, optimization and machine learning: Reading, Mass", D.E. Goldberg, Addison-Wesley, 1989.
5. "Swarm Intelligence", Kennedy, J. and Eberhart, R.C., 2001, Morgan Kaufm

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LBRCE EXAMINATION SECTION

P805 AIRCRAFT STRUCTURES LAB.	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

✓Any of the 10 Experiments are required to be conducted

1. To determine gyroscopic couple on Motorized Gyroscope
2. To find the stability and sensitivity of Watt and Porter governor
3. Balancing of rotating and reciprocating masses
4. Determination of critical speed of shaft with concentration loads
5. Determination of Poisson Ratio
6. Shear Failure of Bolted and Riveted Joints
7. To find the transverse vibrations of free-free and cantilever beam
8. Forced Vibration of Beams
9. To find the coefficient of friction between belt and pulley
10. Combined Bending and Torsion of a Hollow Circular Tube
11. Bending Modulus of a Sandwich Beam
12. Unsymmetrical Bending of a Cantilever Beam
13. Determination of Material Fringe Constant of a Photo Elastic Model
14. Determination of Shear Center of a Channel Section
15. Wagner beam-Tension Field beam
16. Buckling Load of Slender Eccentric Columns
17. Determination of Material Properties of a Composite Laminate
18. Construction of South – well's plot.
19. Verification of Maxwell's Reciprocal theorem
20. Verification of Superposition Theorem

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LBRCE EXAMINATION SECTION

P868 PROPULSION LAB.	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

✓Any of the 10 Experiments are required to be conducted

1. Study of free jet
2. Study of wall jet
3. Study of free convective heat transfer over a flat plate
4. Study of forced convective heat transfer over a flat plate
5. Study of an aircraft jet engine - assembly of sub systems
6. Cascade testing of a model of axial compressor blade row
7. Study of an aircraft piston engine. (Includes study of assembly of sub systems, various components, their functions and operating principles)
8. Study of an aircraft jet engine - various components, their functions and operating principles
9. Study of Properties of aviation fuel
10. Flame stabilization Studies using Conical Flame Holders
11. Burnrate measurements of Solid propellant
12. Study of performance of a propeller
13. Combustion performance studies in a jet engine combustion chamber
14. Study of Co-axial jet
15. Studies on cross-flow
16. Studies on Subsonic Inlets
17. Studies on Supersonic Inlets
18. Study of ramjet

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LBRCE EXAMINATION SECTION

VII-SEMESTER

T352 COMPOSITE MATERIALS AND STRUCTURE	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

STRESS STRAIN RELATION: Introduction- Advantages and application of composite materials, reinforcements and matrices – Generalised Hooke's Law – Elastic constants for anisotropic, orthotropic and isotropic materials.

UNIT- II

METHODS OF ANALYSIS: Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties – Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis – Determination of material properties. Experimental characterization of lamina.

UNIT- III

LAMINATED PLATES: Governing differential equation for a general laminate, angle ply and cross ply laminates.Failure criteria for composites.

UNIT- IV

SANDWICH CONSTRUCTIONS: Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels.

UNIT- V

FABRICATION PROCESSES : Various Open and closed mould processes. Manufacture of fibers – Types of resins and properties and applications – Netting analysis.

TEXT BOOKS

1. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998.
2. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd.,Tokyo, 1998, II edition.

REFERENCES

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.

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T248 MECHANICAL VIBRATIONS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Undamped free vibrations of single degree of freedom systems: Introduction- Differential equation – Solution of differential equation - Torsional vibrations – Equivalent stiffness of spring combinations -Springs in series – Springs in parallel – Natural frequency of a vibration system by energy method.

UNIT - II

Damped free vibrations of single degree of freedom systems: Introduction – Different types of dampings – Free vibrations with viscous damping – Over damped, critically damped and under damped systems -Logarithmic decrement – Viscous dampers

UNIT - III

Forced vibrations of single degree of freedom systems: Introduction – Forced vibrations with constant harmonic excitation – Steady state vibrations – Forced vibration with rotating and reciprocating unbalance -Forced vibrations due to excitation of the support –Vibration isolation and transmissibility - Typical isolators and mount types – vibration measuring instruments

UNIT - IV

Two degrees of freedom systems: Introduction – Principal modes of vibrations – Other cases of simple two degrees of freedom systems – Two masses fixed on a tightly stretched string - Double pendulum – Torsional system – Undamped forced vibrations with harmonic excitation -Undamped dynamic vibration absorber

UNIT - V

Multi degree of freedom systems - Exact analysis- Undamped free vibrations of a multi degree of freedom system – Influence coefficients – Flexibility coefficients and Maxwell reciprocal theorem – Torsional vibrations of multi rotor systems – Vibrations of geared systems - Numerical method – Determination of natural frequency of vibration by Rayleigh's method.

TEXT BOOK

Mechanical vibrations/ G.K.Grover/ Nem chand & Bros.

REFERENCES

1. Theory of vibrations/W.T.Thomson/CBS Publishers.
2. Mechanical vibrations/William W.Seti/ Schaum outline series
3. Mechanical vibrations/V.P.Singh/Dhanpat Rai & Sons.
4. Mechanical Vibrations/S.S.Rao/Pearson Education

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T200 EXPERIMENTAL STRESS ANALYSIS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Stress: Stress at a point - Stress equations of Equilibrium - Laws of stress transformation - Principal stresses – Maximum Shear stress - Dimensional state of stress.

UNIT - II

Strain Measurement: Strain - its relation to experimental determination - properties of strain Gauge systems - Electrical resistance strain gauges - strain gauge circuits - recording instruments - analysis of strain gauge data.

UNIT - III

Moire Methods: Mechanism of formation of Moire fringe - geometrical approach to Moire fringe analysis - displacement field approach to Moire fringe analysis - out of plane measurements experimental procedure.

UNIT - IV

Photo Elasticity Methods: Temporary double refraction - stress optic law - effects of stressed model in a plane polariscope fringe multiplication - isochromatic fringe patterns - isoclinic fringe pattern compensation techniques – calibration methods - separation methods - scaling model to phototype stresses - materials.

UNIT - V

Birefrigent Coatings: Coating stresses and strains - sensitivity - materials and applications - effect of thickness - stress separation.

TEXT BOOK

Experimental Stress Analysis, James Dalley, W.F.Riley, McGraw Hill

REFERENCES

1. Experimental Stress Analysis, Dove Adams, McGraw Hill
2. Strain Gauge Primer , Perry and Lissiener, McGraw Hill
3. Photomechanics, Durelli, Prentice Hall

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T359 INSTRUMENTATION, MEASUREMENTS AND EXPERIMENTS IN FLUIDS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	5	25	75	100

UNIT - I

Need and Objective of Experimental Study: Introduction, Measurement Systems, Performance Terms

Wind Tunnels: Introduction, Classification, Low-speed Wind Tunnels, Power Losses in Wind Tunnel, Energy Ratio, High-speed Wind Tunnels, Instrumentation and Calibration of Wind Tunnels, Wind Tunnel Balance-Wire Balance, Strut-Type, Platform Type, Yoke Type, Strain-Gauge Balance, Balance Calibration

UNIT - II

Flow Visualization and Analog Methods: Introduction, Classification of Visualization Techniques, Smoke Tunnel, Interferometer, Schlieren and Shadowgraph, Hele-Shaw Apparatus, Electrolytic Tank, Hydraulic Analogy, Hydraulic Jumps

UNIT - III

Velocity Measurement: Introduction, Velocity & Mach number from pressure measurements, Laser droplet anemometer- LDA Principle, Doppler shift equation, Reference beam system, Fringe system. Measurement of velocity by Hot-Wire Anemometer- Constant Current Hot-Wire Anemometer (CCA), Constant Temperature Hot-Wire Anemometer, Hot-Wire Probes, Limitations of Hot-Wire Anemometer, Measurement of velocity using vortex shedding Technique, Fluid Jet Anemometer

UNIT - IV

Pressure Measurement Techniques: Introduction, Barometers, Manometers, Dial type pressure gauge, Pressure Transducers, Pitot, Static, and Pitot-Static Tube and Its characteristics, Flow direction measurement probes and Low Pressure Measurement Gauges

Temperature measurement: Introduction, Types of thermometers, Thermocouples, RTD, Thermisters, Pyrometers, Temperature measurement in fluid flows

UNIT - V

Data Acquisition: Introduction, Data Acquisition Principle, Generation of Signal, Signal Conditioning, Multiplexing, Data Conversion, Data Storage and Display, Data Processing, Digital Interfacing, Data Acquisition using Personal Computers

Uncertainty Analysis: Introduction, Estimation of measurement errors, External estimation of errors, Internal estimate of the error, Uncertainty Analysis- Uses of uncertainty analysis, Uncertainty estimation, General procedure- Uncertainty in flow Mach number, Uncertainty calculation

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TEXT BOOK

Instrumentation, Measurements and Experiments in Fluids, E. Rathakrishnan, CRC press, 2007.

REFERENCES

1. Experimental methods for Engineers, Jack Philip Holman, Walter J. Gajda, Edition: 4, McGraw-Hill, 1984.
2. Rae, W.H. and Pope, A., Low Speed Wind Tunnel Testing, John Wiley Publication, 1984.
3. Pope, A., and Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985. Bradsaw Experimental Fluid Mechanics.
4. Measurement Systems, Ernest Doebelin, McGraw Hill Professional, 2003.
5. Mechanical Measurements, Thomas G. Beckwith, Nelson Lewis Buck, Edition: 5, Addison- Wesley Pub. Co., 1961.

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T230 INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	4	25	75	100

UNIT - I

Introduction: Computational Fluid Dynamics as a Research and Design Tool, Applications of Computational Fluid Dynamics
Governing Equations of Fluid Dynamics: Introduction, Control Volume, Substantial Derivative, Divergence of Velocity, Continuity Equation, Momentum Equation and Energy Equation, Conservation and Non-conservation forms

UNIT - II

Mathematical Behavior of Partial Differential Equations:
Introduction, Classification of Quasi-Linear Partial Differential Equations, Eigen Value Method, Hyperbolic Equations, Parabolic Equations, Elliptic Equations

UNIT - III

Basics Aspects of Discretization: Introduction, Introduction of Finite Differences, Difference Equations, Explicit and Implicit Approaches, Errors and Stability Analysis, Grid Generation

UNIT - IV

Incompressible Fluid Flow: Introduction, Implicit Crank-Nicholson Technique, Pressure Correction Method, Computation of Boundary Layer Flow

UNIT - V

Heat Transfer: Finite Difference Applications in Heat conduction and Convention – Heat conduction, steady heat conduction, in a rectangular geometry, transient heat conduction, Finite difference application in convective heat transfer.

TEXT BOOK

Computational fluid dynamics - Basics with applications - John. D. Anderson / Mc Graw Hill.

REFERENCES

1. Computational Fluid Mechanics and Heat Transfer, Anderson, D.A.,Tannehill, I.I., and Pletcher, R.H.,Taylor and Francis
2. Numerical heat transfer and fluid flow / Suhas V. Patankar- Butter-worth Publishers
3. Fundamentals of Computational Fluid Dynamics, T. K Sengupta, University Press

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T212 HELICOPTER AERODYNAMICS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

ELMENTS OF HELICOPTER AERODYNAMICS: Configurations based on torque reaction-Jet rotors and compound helicopters- Methods of control – Collective and cyclic pitch changes - Lead - Lag and flapping hinges.

UNIT - II

IDEAL ROTOR THEORY: Hovering performance - Momentum and simple blade element theories - Figure of merit - Profile and induced power estimation - Constant chord and ideal twist rotors.

UNIT - III

POWER ESTIMATES: Induced, profile and parasite power requirements in forward flight- performance curves with effects of altitude-Preliminary ideas on helicopter stability

UNIT - IV

LIFT, PROPULSION AND CONTROL OF V/STOL AIRCRAFT: Various configuration - Properller, rotor, ducted fan and jet lift - Tilt wing and vectored thrust - Performance of VTOL and STOL aircraft in hover, transition and forward motion.

UNIT - V

GROUND EFFECT MACHINES: Types - Hover hieight, lift augmentation and power calculations for plenum chamber and peripheral jet machine - Drag of hovercraft on land and water. Applications of hovercraft.

REFERENCES

1. Aerodynamics of Helicopter, Gessow, A., and Myers, G.C MacMillan & Co., N.Y. 1987.
2. Aerodynamics of V/STOL Flight , McCormick, B.W., Academic Press, 1987.
3. Helicopter Theory , Johnson, W., Princeton university Press, 1980.
4. Aerodynamics, Aeronautics & Flight Mechanics , McCormick, B.W., John Wiley, 1995.
5. Helicopter Engineering, Gupta, L., Himalayan Books, 1996.

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T326 THEORY OF PLATES AND SHELLS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

CLASSICAL PLATE THEORY: Plate Structures in aerospace vehicles-Classical Plate Theory– Assumptions – Differential Equation – Boundary Conditions, Axi-Symmetric Loading

UNIT - II

PLATES OF VARIOUS SHAPES: Navier's Solution and energy method-Rectangular and circular plates with various end conditions – Levy's Method of Solution for Rectangular Plates under Different Boundary Conditions.

UNIT - III

EIGEN VALUE ANALYSIS: Stability and free Vibration Analysis of Rectangular Plates.

UNIT - IV

APPROXIMATE METHODS: Rayleigh – Ritz, Galerkin Methods– Finite Difference Method – Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

UNIT - V

SHELLS: Shell structures in aerospace vehicles- Basic Concepts of Shell Type of Structures – Membrane analysis and Bending Theories forCircular Cylindrical Shells.

REFERENCES

1. Timoshenko, S.P. Winowsky. S., and Kreger, "Theory of Plates and Shells", McGraw-Hill Book Co. 1990.
2. T. K. Varadan and K. Bhaskar, "Theory of Plates and Shells",1999, Narosa .
3. Flugge, W. "Stresses in Shells", Springer – Verlag, 1985.
4. Timoshenko, S.P. and Gere, J.M., "Theory of Elastic Stability", McGraw-Hill Book Co. 1986
5. K.Chandrashekhara, "Theory of Plates", University of Press,2001.

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T353 CONTROL ENGINEERING	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

OBJECTIVE

In this course it is aimed to introduce to the students the principles and applications of control systems in everyday life. The basic concepts of the block diagram reduction, time domain analysis solutions to time invariant systems and also deals with the different aspects of stability analysis of systems in frequency domain and time domain.

UNIT - I

Introduction

Simple pneumatic, hydraulic and thermal systems, analogies-mechanical and electrical components-development of flight control systems-Modeling of translational and rotational mechanical systems

UNIT - II

Open loop and Closed loop control systems

Concepts of control systems- Open loop and closed loop control systems. Characteristics of feedback control systems: System concept, differential equations and transfer functions. Block diagram representation of systems – Block diagram reduction methods – Closed loop transfer function, determination of signal flow graph. Mason's gain formula. .

UNIT - III

Time domain analysis

Test signals – time response of first order and second order systems – time domain specifications – types and order of systems – generalized error co-efficient – steady state errors.

UNIT - IV

Concept of Stability

Concepts of stability –necessary and sufficient conditions- Routh-Hurwitz stability – root locus technique – correlation between time and frequency response – stability analysis using Bode plots- Gain margin – phase margin, Polar plots

UNIT - V

State variable analysis

State variable methods - introduction to the state variable concept - state space models -physical variable - phase variable and diagonal forms from time domain - solution of state equations - properties of state transition matrix - relation between transfer function and state space models, Controllability and Observability.

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REFERENCES

1. Modern Control Engineering, Ogata.K, Prentice Hall of India, 5th Edition.
2. Automatic Control Systems, Benjamin.C.Kuo, 7th Edition – Prentice Hall of India, 2002.
3. Control Systems, M.Gopal, Tata McGraw-Hill, 1997.
4. Modern Control Systems", Dorf R.C. & Bishop R.H., Addison Wesley.
5. Control System Engineering, 3rd Edition, Nagrath & Gopal, New Age International Edition, 2002.

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LBRCE EXAMINATION SECTION

T362 SATELLITE TECHNOLOGY	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

INTRODUCTION TO SATELLITE SYSTEMS: Common satellite applications and mission- Typical spacecraft orbits- Definitions of spin the three axis stabilization- Space environment- Launch vehicles-Satellite system and their functions (structure, thermal, mechanisms, power, propulsion, guidance and control, bus electronics).

UNIT - II

ORBITAL MECHANICS: Fundamental of flight dynamics – Time and coordinate systems-Orbit determination and prediction-Orbital maneuvers-GPS Systems and application for satellite/Orbit determination-Ground station network requirements

UNIT - III

SATELLITE STRUCTURES AND THERMAL CONTROL: Satellite mechanical and structural configuration: satellite configuration choices, launch loads, separation induced loads, deployment requirements-Design and analysis of satellite structures-Structural materials and fabrication-The need of thermal control: externally induced thermal environment-Internally induced thermal environment-Heat transfer mechanism: internal to the spacecraft and external heat load variations –Thermal control systems, active and passive methods.

UNIT - IV

SPACECRAFT CONTROL: Control requirements: attitude control and station keeping functions type of control maneuvers-Stabilization schemes: spin stabilization, gravity gradient methods, 3 axis stabilization-Commonly used control systems: mass expulsion systems, Momentum exchange Systems, gyro and magnetic torquer-sensors star and sun sensor, earth sensor, magnetometers and inertial sensors

UNIT - V

POWER SYSTEM AND BUS ELECTRONICS: Solar panels: Silicon and Ga-As cells, power generation capacity, efficiency-Space battery systems-battery types, characteristics and efficiency parameters-Power electronics. Telemetry and tele command systems. Tm&Tc functions, generally employed communication bands (UHF/VHF, S,L,Ku, Ka etc), their characteristics and applications-Coding systems – Onboard computer –Ground checkout systems.

LBRCE EXAMINATION SECTION

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REFERENCES

1. Analysis and Design of Flight Vehicle Structures, Tri-State off set company, USA -1980
2. Space Systems Engineering Rilay, FF, McGraw Hill 1982
3. Principles of Astronoautics Vetregt.M.,Elsvier Publishing company 1985
4. Introduction space flight, franceis J.Hale Prentice Hall, 1994
5. Space Vehicle Design, Michael D.Griffin and James R.French, A IAAEducation series, 1991
6. Spacecraft Thermal control, hand Book, Aerospace press 2002
7. Structural Design of Missiles & Space craft Lewis H.Abraham, Mc Grahill 1992
8. Space communication systems, Richard.F, Filipowsky Eugan I Muehllorf princtice Hall 1995
9. Hughes, P.C.Space craft altitude Dynamics, Wisey, 1986
10. Gebmart, Heat Transfer, Mc GRAW HILL, Martin J.Communication satellite systems, Mc Graw Hill, 1978.

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LBRCE EXAMINATION SECTION

T351 COMBUSTION	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

Fundamental Concepts: Thermo chemical equations - Heat of reaction first order, second order and third order reactions – premixed flames - Diffusion flames - Measurement of burning velocity - Various methods - Effect of various parameters on burning velocity - Flame stability - Detonation - Deflagration - Rankine - Hugoniot curve - Radiation by flames.

UNIT - II

Combustion in Aircraft Piston Engine: Introduction to Combustion in Aircraft Piston Engines, Various Factors affecting the combustion Efficiency, Fuels used for Combustion in Aircraft Piston Engines and their Selection, Detonation in Piston Engine Combustion and The Methods to Prevent the Detonation

UNIT - III

Combustion in Gas Turbines Engines: Combustion in gas turbine combustion chambers - Re-circulation - Combustion efficiency - Factors affecting combustion efficiency - Fuels used for gas turbine combustion chambers - Combustion stability – Ramjet Combustion, Flame holder types

UNIT - IV

Combustion in Rockets: Solid propellant combustion - Double base and composite propellant combustion - Various combustion models -Combustion in liquid rocket engines - Single fuel droplet combustion model - Combustion in hybrid rockets.

UNIT - V

Supersonic Combustion: Introduction to Supersonic combustion, Need for supersonic combustion for hypersonic airbreathing propulsion, Supersonic combustion controlled by diffusion and heat convection - Analysis of reaction and mixing processes - Supersonic burning with detonation shocks.

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REFERENCES

1. Sharma,S.P., and Chandra Mohan, Fules and Combustion, Tata McGraw Hill Publishing Co., Ltd., New Delhi 1987.
2. Mathur, M., and Sharma, R.P., Gas turbines and Jet and Rocket Propulsion, Standard Publishers, New Delhi, 1988.
3. Loh, W.H.T., Jet Rocket, Nuclear, Ion and Electric Propulsion Theory and Design, Springer Verlag, New York 1982
4. Beer, J.M. and Chigier, N.A.Combustion Aerodynamics, Applied Science Publishers Ltd., London, 1981.
5. Chowdhury,R., Applied Engineering Thermodynamics, Khanna Publishers, New Delhi, 1986
6. Sutton, G.P., et al Rocket Propulsion Elements, John Wiley and Sons, Inc., New York, 1993.
7. Fundamentals of Combustion, D.P Mishra, PHI Learning Pvt. Ltd., 2008

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T884 AIRCRAFT COMPONENT MODELING AND ANALYSIS LAB	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

1. Design of joints- bolted, riveted and welded joints
2. Design and Drafting Control Components Cam
3. Design and Drafting Control Components Bell Crank
4. Design and Drafting Control Components Gear
5. Design and Drafting Control Components Push-pull rod
6. Drafting of aircraft wing structural elements
7. Drafting of aircraft fuselage structural elements
8. Three view diagram of a typical aircraft
9. Layout of Control System
10. Estimation of forces and design of members in plane and space trusses using C- program
11. Estimation of forces and design of members in plane and space trusses using software package
12. Static analysis of beams using software packages
13. Static analysis of plates
14. Static analysis of shells
15. Dynamic analysis of beams
16. Thermal analysis of structures

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LBRCE EXAMINATION SECTION

T804 AIRCRAFT DESIGN PROJECT	L	T	P	Credits	Internal	External	TOTAL
	0	0	3	2	25	75	100

1. Comparative study of different types of airplanes and their specifications and performance details
2. Preliminary weight estimations, selection of main parameters, Power plant selection, Aerofoil selection, Wing, tail and control surfaces, Landing Gear
3. Preparation of layouts of balance diagram and three view drawings
4. Drag estimation, performance calculations and stability estimates, V-n diagram for the design study
5. Preliminary design of an aircraft fuselage, load distribution on an aircraft fuselage
6. Preliminary design of an aircraft fuselage-design of bulkheads and longerons
7. Preparation of a detailed design report with drawings.

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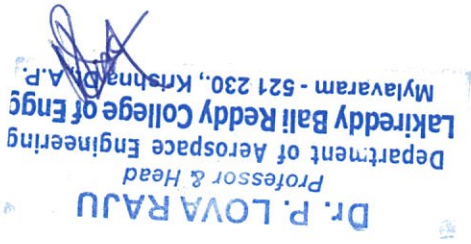
VIII-SEMESTER



T401 PRINCIPLES OF MANAGEMENT AND ETHICS	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	4	25	75	100

Objectives: To familiarise students with the management concepts, functions and processes. Also to make them socially responsible by demonstrating ethical behavior while discharging duties in their professional life.

UNIT- I

Management: Definition and nature; Goals and Levels of management; Managerial functions; Managing people for competitive advantage.
Planning: Nature and Importance, Types of planning, Planning Process; MBO: Process – Advantages and Disadvantages; Decision making, Significance.

UNIT- II

Organizing: Nature, Formal and Informal Organisations, Organization levels and span of management; Departmentation - Modern Organisational Structures – Characteristics; Line and Staff concepts - Delegation, Centralization and Decentralization of authority;
Staffing: Definition– Recruitment: sources - Selection: Process – Performance Appraisal.

UNIT- III

Directing: Meaning, Assumptions of Human Behaviour: Theory X & Theory Y; Leadership: Definition, Leadership behavior and styles, Recent approaches to leadership; Managerial Grid; Communication: Process, Methods;
Controlling: Nature and importance – Process – Feedback system – Requirements for effective control – Control techniques.

UNIT - IV

ENGINEERING ETHICS & HUMAN VALUES:
Senses of 'Engineering Ethics', variety of moral issues, Moral dilemma and moral autonomy, Integrity, work Ethics, Respect for others, caring & sharing, Empathy, Service learning, character, spirituality, collegiality & loyalty, collective bargaining.

UNIT - V
Engineer as a social Experimenter: Engineering as Experimentation, Engineers as responsible experimenters, code of ethics (specific to a particular Engineering Discipline), Engineers as expert witnesses & advisors.

Safety & Responsibility; Safety, Risk, assessment of risk, risk benefit analysis, confidentiality, Case studies: The Challenger, The Three Mile Island, Chernobyl & Bhopal gas tragedy.

T130 BOUNDARY LAYER THEORY	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

Fundamental Equations of Viscous Flow: Fundamental Equations of Viscous Flow, Conservation of Mass, Conservation of Momentum-Navier-Stokes Equations, Energy equation, Dimensional Parameters in Viscous Flow, Non dimensionalising the Basic Equations and Boundary conditions

UNIT - II

Solutions of Viscous Flow Equations: Couette Flows, Hagen-Poiseuille Flow, Flow between Rotating concentric Cylinders, Combined Couette-Poiseuille Flow between Parallel Plates, Creeping Motion, Stokes Solution for an Immersed Sphere, Development of boundary layer - Estimation of boundary layer thickness-Displacement thickness, momentum and energy thickness for two-dimensional flows

UNIT - III

Laminar Boundary Layer: Laminar boundary layer equations, Flat Plate Integral analysis of Energy equation, flow separation - Blasius solution for flat-plate flow – Falkner-Skan Wedge flows - Boundary layer temperature profiles for constant plate temperature – Integral equation of Boundary layer - Pohlhausen method - Thermal boundary layer calculations

UNIT - IV

Turbulent Boundary Layer: Turbulance-physical and mathematical description, Two-dimensional turbulent boundary layer equations - Velocity profiles - The law of the wall - The law of the wake - Turbulent flow in pipes and channels - Turbulent boundary layer on a flat plate - 'Boundary layers with pressure gradient, Eddy viscosity, Mixing length, Turbulence modeling

UNIT - V

Compressible Boundary Layer: Compressible boundary layer equation, Recovery factor, similarity solutions, laminar supersonic cone rule, shock-boundry layer interaction.

REFERENCES

1. White, F.M.,"Viscous Fluid Flow" , McGraw Hill Book Co.,Inc., New York, 1985
2. Reynolds, A.J., " Turbulent Flows in Engineering " , John Wiley & Sons, 1980.
3. Panton, R.L., " Incompressible Flow ", John Wiley and Sons, 1984.
4. Anderson, J.D., " Fundmentals of Aerodynamics " , McGraw Hill Book Co., Inc., New York, 1985.
5. Schlichting, H., " Boundary Layer Theory ", McGraw Hill New York, 1979.

T149 CRYOGENICS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

Introduction to Cryogenic System: Introduction- Historical development- Mechanical Properties –Thermal properties-Electric and Magnetic properties – Properties of cryogenic fluids.

UNIT - II

Gas Liquefaction : Minimum work for liquefaction – Methods to produce low temperature – Liquefaction systems for gases other than Neon, Hydrogen and Helium. Liquefaction systems for Neon, Hydrogen and Helium.

UNIT - III

Components of Liquefaction Systems: Heat Exchangers – Compressors and Expanders – Expansion valve – Losses for real machines.

UNIT - IV

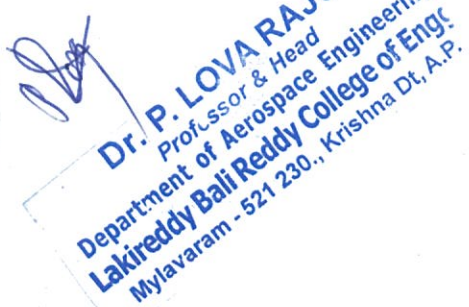
Gas Separation and Purification System: Properties of mixtures – Principles of mixtures – Principles of gas separation – Air separation systems. Cryogenic Refrigeration system – Working media – Solids, Liquids and gases.

UNIT - V

Cryogenic fluid Storage & Transfer – Cryogenic storage systems – Insulation Fluid transfer mechanics – Cryostat – Cryo Coolers.
Applications: Space technology – in- flight air separation and collection of LOX – Gas Industry – Biology - Medicine - Electronics.

REFERENCES

1. Cryogenic Systems- R..Barron. Mc Graw Hill company.
2. Cryogenic Research and Applications-Marshal Sitting, Von Nostrand Inc, New Jersey
3. Cryogenics Engineering –R.B. Scott, Von Nostrand Inc, New Jersey
4. Cryogenic Engineering -Huston: McGraw Hill
5. Refrigeration and Air-conditioning - Arora & Domkundwar, Dhanpat Rai & Co
6. Hand book of cryogenic engineering-J.G.Weisend-II, Taylor and Francis,1998.



T202 FATIGUE AND FRACTURE MECHANICS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

FATIGUE OF STRUCTURES: S-N curves - Endurance limit - Effect of mean stress and ,variable stress, Gerber, Goodman and Soderberg relations and diagrams - Design of components subjected to axial, bending, torsion loads and combination of them. Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S-N curves.

UNIT - II

STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR: Low cycle fatigue and high cycle fatigue - Coffin - Manson's relation - Transition life – cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques - Cumulative damage - Miner's theory - Other theories.

UNIT - III

PHYSICAL ASPECTS OF FATIGUE AND FRACTURE: Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations -fatigue fracture surfaces - Strength and stress analysis of cracked bodies – Potential energy and surface energy - Griffith's theory - Effect of thickness on fracture toughness - stress intensity factors for typical geometries.

UNIT - IV

FATIGUE DESIGN AND TESTING: Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

UNIT - V

FUNDAMENTALS OF FAILURE ANALYSIS: Common causes of failure. Principles of failure analysis. Fracture mechanics approach to failure problems. Techniques of failure analysis. Service failure mechanisms – ductile and brittle fracture, fatigue fracture, wear failures, fretting failures, environment induced failures, high temp. failure. Faulty heat treatment and design failures, processing failures (forging, casting, machining etc.),

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REFERENCES

1. Prasanth Kumar – "Elements of fracture mechanics" – Wheeter publication, 1999.
2. Barrois W, Ripely, E.L., "Fatigue of aircraft structure", Pe/gamon press. Oxford, 1983.
3. Knott, J.F., "Fundamentals of Fracture Mechanics", Buterworth & Co., Ltd., London, 1983
4. Sin, C.G., "Mechanics of fracture" Vol. I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
5. Subra suresh, "Fatigue of materials" , II edition, 1998.
6. T. L. Anderson, "Fracture mechanics: Fundamentals and applications", III edition, 2004.

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T349 AIRFRAME REPAIR AND MAINTENANCE	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

WELDING IN AIRCRAFT STRUCTURAL COMPONENTS: Equipments used in welding shop and their maintenance – Ensuring quality welds –Welding jigs and fixtures – Soldering and brazing.
SHEET METAL REPAIR AND MAINTENANCE: Inspection of damage – Classification – Repair or replacement – Sheet metal inspection – N.D.T. Testing – Riveted repair design, Damage investigation – reverse technology.

UNIT - II

PLASTICS AND COMPOSITES IN AIRCRAFT: Review of types of plastics used in airplanes – Maintenance and repair of plastic components – Repair of cracks, holes etc., various epair schemes – Scopes.Inspection and Repair of composite components – Special precautions – Autoclaves.

UNIT - III

AIRCRAFT JACKING, ASSEMBLY AND RIGGING: Airplane jacking and weighing and C.G. Location. Balancing of control surfaces –Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

UNIT - IV

REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM: Trouble shooting and maintenance practices – Service and inspection. – Inspection and maintenance of landing gear systems. – Inspection and maintenance of air-conditioning and pressurisation system, water and waste system. Installation and maintenance of Instruments – handling – Testing – Inspection. Inspection and maintenance of auxiliary systems – Fire protection systems – Ice protection system – Rain removal system – Position and warning system – Auxiliary Power Units (APUs)

UNIT - V

SAFETY PRACTICES: Hazardous materials storage and handling, Aircraft furnishing practices – Equipments. Trouble shooting - Theory and practices.

REFERENCES

1. KROES, WATKINS, DELP, "Aircraft Maintenance and Repair", McGraw-Hill, New York, 1992.
2. LARRY REITHMEIR, "Aircraft Repair Manual", Palamar Books, Marquette, 1992.
3. BRIMM D.J. BOGGES H.E., "Aircraft Maintenance", Pitman Publishing corp. New York, 1940

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T345 ADVANCED PROPULSION SYSTEMS	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	3	25	75	100

UNIT - I

SCRAMJET PROPULSION SYSTEM: Fundamental considerations of hypersonic air breathing vehicles – Preliminary concepts in engine airframe integration – calculation of propulsion flow path – flowpath integration – Various types of supersonic combustors – fundamental requirements of supersonic combustors – Mixing of fuel jets in supersonic cross flow – performance estimation of supersonic combustors.

UNIT - II

NUCLEAR PROPULSION SYSTEMS: Overview, Fission Propulsion, Radioisotope Nuclear Rocket, Fusion Propulsion-Inertial, Magnetic, Inertial Electrostatic Confinement, Antimatter Propulsion, Nuclear rocket engine design and performance – nuclear rocket reactors – nuclear rocket nozzles – nuclear rocket engine control — basic thruster configurations – thruster technology – heat source development – nozzle development – nozzle performance of radiosotope propulsion systems.

UNIT - III

ELECTRIC PROPULSION SYSTEMS: Basic concepts in electric propulsion – power requirements and rocket efficiency –Electrothermal-Resistojet-Arcjet-Solar-laser-Microwave Thermal Propulsion, Electrostatic-Ion-Hall-Field Emission and Colloid Thrusters- Laser Accelerated Plasma Propulsion, Electromagnetic-MPD,PPT

UNIT - IV

MICROPROPULSION: Chemical Propulsion-Solid Microthrusters-Micro Mono Propellant Thruster-Micro Bipropellant Thruster, Cold Gas Thruster, Electric Propulsion-Micro Ion Thruster-Low Power Hall Thruster-Micro PPT Thruster-MEMS FEEP/Colloid Thruster- Microchip laser Thruster

UNIT - V

PROPELLANTLESS PROPULSION: Tethers-Momentum Exchange Tether-Electrodynamic Tether, Propellantless Electric/Nuclear Propulsion, Photons Rocket, Beamed Energy Earth-to-Orbit Propulsion, Solar Sails, Magnetic Sails

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REFERENCES

1. Advanced Space Propulsion Systems, Martin Tajma, Springer
2. Advanced propulsion systems and technologies, today to 2020 Claudio Bruno, Antonio G. Accettura
3. Rocket And Spacecraft Propulsion: Principles, Practice And New Developments Martin J. L. Turner, Springer
4. William H. Heiser and David T. Pratt, Hypersonic Airbreathing propulsion, AIAA Education Series, 2001.
5. Fortescue and Stark, Spacecraft Systems Engineering, 1999.
6. Cumpsty, Jet propulsion, Cambridge University Press, 2003.

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T348 AERO ENGINE REPAIR AND MAINTENANCE	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

CLASSIFICATION OF PISTON ENGINE COMPONENTS : Types of piston engines – Principles of operation – Function of components – Materials used – Details of starting the engines – Details of carburetion and injection systems for small and large engines – Ignition system components – Spark plug details – Engine operating conditions at various altitudes – Maintenance and inspection check to be carried out.

UNIT - II

INSPECTIONS OF PISTON ENGINES: Inspection and maintenance and trouble shooting – Inspection of all engine components – Daily and routine checks – Overhaul procedures – Compression testing of cylinders – Special inspection schedules – Engine fuel, control and exhaust systems – Engine mount and super charger – Checks and inspection procedures.

UNIT - III

OVERHAULING OF PISTON ENGINES: Symptoms of failure – Fault diagnostics – Case studies of different engine systems –Tools and equipment requirements for various checks and alignment during overhauling – Tools for inspection – Tools for safety and for visual inspection – Methods and instruments for non destructive testing techniques – Equipment for replacement of part and their repair. Engine testing: Engine testing procedures and schedule preparation – Online maintenance

UNIT - IV

CLASSIFICATION OF JET ENGINE COMPONENTS: Types of jet engines – Principles of operation – Functions of components – Materials used – Details of starting and operating procedures – Gas turbine engine inspection & checks – Use of instruments for online maintenance – Special inspection procedures : Foreign Object Damage – Blade damage – etc. Maintenance procedures of gas turbine engines – Trouble shooting and rectification procedures – Component maintenance procedures – Systems maintenance procedures. Gas turbine testing procedures – test schedule preparation – Storage of Engines –Preservation and de-preservation procedures

UNIT - V

OVERHAUL PROCEDURES: Engine Overhaul procedures – Inspections and cleaning of components – Repairs schedules for overhaul – Balancing of Gas turbine components. Trouble Shooting - Procedures for rectification – Condition monitoring of the engine on ground and at altitude – engine health monitoring and corrective methods.

EXAMINATION SECTION

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REFERENCES

1. Aircraft Power plants, KROES & WILD 7th Edition – McGraw Hill, New York, 1994.
2. Gas Turbine Engines, TURBOMECA, The English Book Store, New Delhi, 1993.
3. The Aircraft Gas turbine Engine and its Operation, (latest edition), UNITED TECHNOLOGIES PRATT & WHITNEY The English Book Store, New Delhi.

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T364 WIND ENGINEERING	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

THE ATMOSPHERE: Atmospheric Circulation – Stability of atmospheres – definitions & implications – Effects of friction – Atmospheric motion – Local winds, Building codes, Terrains different types

UNIT - II

ATMOSPHERIC BOUNDARY LAYER: Governing Equations – Mean velocity profiles, Power law, logarithmic law wind speeds, Atmospheric turbulence profiles – Spectral density function – Length scale of turbulence, Roughness parameters simulation techniques in wind tunnels

UNIT - III

BLUFF BODY AERODYNAMICS: Governing Equations – Boundary layers and separations – Wake and Vortex formation two dimensional – Strouhal Numbers, Reynolds numbers– Separation and Reattachments Oscillatory Flow patterns Vortex sheding flow switching– Time varying forces to wind velocity in turbulent flow – Structures in three dimensional

UNIT - IV

WIND LOADING: Introduction, Analysis and synthesis loading coefficients, local & global coefficients pressure shear stress coefficients, force and moment coefficients – Assessment
methods – Quasi steady method – Peak factor method – Extreme value method

UNIT - V

AEROELASTIC PHENOMENA: Vortex shedding and lock in phenomena in turbulent flows, across wind galloping wake galloping - Torsional divergence, along wind galloping of circular cables, cross wind galloping of circular cables, Wind loads & their effects on tall structures – Launch vehicles

REFERENCES

1. Emil Simiu & Robert H Scanlan, Wind effects on structures - fundamentals and applications to design, John Wiley & Sons Inc New York, 1996.
2. Tom Lawson Building Aerodynamics Imperial College Press London, 2001
3. N J Cook, Design Guides to wind loading of buildings structures Part I & II, Butterworths, London, 1985
4. IS: 875 (1987) Part III Wind loads, Indian Standards for Building codes.

T360 LAUNCH VEHICLE AERODYNAMICS	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

LAUNCH VEHICLE CONFIGURATIONS AND DRAG ESTIMATION: Types of Rockets and missiles-various configurations-components-forces on the vehicle during atmospheric flight-nose cone design and drag estimation

UNIT - II

AERODYNAMICS OF SLENDER AND BLUNT BODIES: Aerodynamics of slender and blunt bodies, wing-body interference effects-Asymmetric flow separation and vortex shedding-unsteady flow characteristics of launch vehicles- determination of aero elastic effects, Slender Bodies of Revolution, non circular shapes, lifting surfaces, low Aspect Ratio characteristics, wing-body-tail interference, prediction of overall characteristics of body dominated configurations and lifting surface dominated configurations, high angle of attack aerodynamics

UNIT - III

HYPERSONIC AERODYNAMICS: Introduction to hypersonic aerodynamics, concept of thin shock layers-hypersonic flight paths-hypersonic similarity parameters-shock wave and expansion wave relations of in viscid hypersonic flows, Shock wave -boundary layer interactions, aerodynamic heating

UNIT - IV

AERODYNAMIC ASPECTS OF LAUNCHING PHASE: Booster separation-cross wind effects-specific considerations in missile launching-missile integration and separation-methods of evaluation and determination- Stability and Control Characteristics of Launch Vehicle Configuration- Wind tunnel tests – CFD Analysis.

UNIT - V

AERODYNAMIC LAUNCHING PROBLEMS: Introduction, Safety of parent Aircraft, Launch Boundaries-Launch-Aircraft Trajectory, Parent Aircraft Performance, Ground Launch

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REFERENCES

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2. Hypersonic and High Temperature Gas Dynamics, Anderson, J.D., AIAA Education Series.
3. Missile Aerodynamics, Nielson, Jack N, Stever, Gutford, Mc Graw Hill, New York, 1960.
4. Modern compressible flows, Anderson Jr., D., McGraw-Hill Book Co., New York 1999.
5. Spacecraft Mission Design, Charles D.Brown, AIAA Education Series, Published by AIAA, 1998
6. Elements of Space Technology for Aerospace Engineers, Meyer Rudolph X, Academic Press, 1999

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T357 HIGH-SPEED JETS	L	T	P	Credits	Internal	External	TOTAL
	4	0	0	3	25	75	100

UNIT - I

Fundamental Aspects of Jet Flows: Introduction, Classification of Free Jets, and its Characteristics, Equations of Motion, Theory of Turbulent Jets-Mean Velocity and Mean Temperature, Turbulence Characteristics of Free Jets, Entrainment, Jet Test Facility

UNIT - II

Subsonic Jet Characteristics: Introduction, 2-D Equations of Compressible Jet, Generation of Subsonic Jets, Flow Regimes and Characteristics of Subsonic Jet, Mixing Mechanism, Large Scale and Small Scale Structures in Subsonic Shear Layers

UNIT - III

Supersonic Jet Characteristics: Introduction, Expansion Levels, Generation of Supersonic jets, Flow Regimes and Characteristics of Supersonic Jets, Mechanism of Jet Mixing, Correctly Expanded, Overexpanded and Underexpanded Jet Characteristics, Shock-cells, Mach Disc, Shock reflection

UNIT - IV

Jet Control Techniques: Introduction, Classification of Control Methods-Active and Passive, Role of Shear layer in Flow Control, Subsonic Shear Layer, Supersonic Shear Layer, Non-Circular Jets, Tab Controlled Jets

UNIT - V

Jet Acoustics: Introduction, Strouhal Number, Turbulence Mixing Noise, Broad Band Shock Associated Noise, Screech Tones, Mach Wave Radiation, Measurement of Jet Noise-Frequency Spectrum, OSPL, Anchoic Chamber

REFERECNES

Fluid Dynamics of jets, SHIH-I PAI,
Applied Gas Dynamics, E. Rathakrishnan, John Wiley and Sons (Asia) P.Ltd, 2010
Acoustic Control of Turbulent Jets, A.S. Ginevsky, Y.V. Vlasov, R.K. Karavosov, Springer
Turbulent Jets, N. Rajaratnam, Elsevier

LBRCE EXAMINATION SECTION

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T346 AERO ELASTICITY	L	T	P	Credits	Internal	External	TOTAL
	4	1	0	3	25	75	100

UNIT - I

AEROELASTICITY PHENOMENA: Vibration of Beams due to Coupling and Torsion, The Aero-elastic Triangle of Forces, Stability versus Response Problems, Aeroelasticity in Aircraft Design, Vortex Induced Vibration

UNIT - II

DIVERGENCE OF A LIFTING SURFACE: Simple Two Dimensional Idealizations, Strip Theory, Fredholm Integral Equation of the Second Kind, Exact solutions for simple rectangular wings, Semirigid assumption and approximate solutions, Generalized coordinates, Successive approximations, Numerical approximations using matrix equations.

UNIT - III

STEADY STATE AEROELASTIC PROBLEMS: Loss and reversal of aileron control, Critical aileron reversal speed, Aileron efficiency, Semirigid theory and successive approximations, Lift distributions, Rigid and elastic wing.

UNIT - IV

FLUTTER PHENOMENON: Non-dimensional parameters, Stiffness criteria, Dynamic mass balancing, Model experiments, Dimensional similarity, Flutter analysis, Two dimensional thin airfoils in steady incompressible flow, Quasi-steady aerodynamic derivatives, Galerkin method for critical speed, Stability of distributed motion, Torsion flexure flutter, Solution of the flutter determinant, Methods of determining the critical flutter speeds, Flutter prevention and control.

UNIT - V

AEROELASTIC PROBLEMS IN CIVIL AND MECHANICAL ENGINEERING: Galloping of transmission lines and flow induced vibrations of tall slender structures and suspension bridges.

REFERENCES

1. An Introduction to the Theory of Aeroelasticity , Fung, Y.C., John Wiley & Sons Inc., New York 1985.
2. Aeroelasticity , Bisplinghoff., R.L., Ashley, H., and Halfmann, R.L., Addison Wesley Publishing Co., Inc., II ed, 1987.
3. Elementary Theory of Aeroelasticity, Broadbent, E.G., BunHill Publications Ltd., 1986.
4. Introduction to the Study of Aircraft Vibration and Flutter, Scanlan, R.H. and Rosenbaum, R., MacMillan Co., N.Y., 1991.