GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

INTRODUCTION TO STRENGTH OF MATERIALS (Code :3340101)

Diploma Programme in which this course is offered	Semester in which offered
Aeronautical Engineering	Fourth

1. RATIONALE

All Aircraft components are subjected to different loadings and behave in a specific way. In this course, analysis of determinate structures under various kinds of loadings will be taught. Also, strength and properties of the cross-section and its response in terms of stress and strain will also be focused. This course will lay sound foundation to analysis & design of Aircraft Structure.

2. LIST OF COMPETENCIES

→ Understand the behaviour and analyze statically determinate structure like beam, column & shaft under static loads & twisting moments.

3. TEACHING AND EXAMINATION SCHEME.

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	150
04	00	02	06	70	30	20	30	

Legends: **L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment.

4. DETAILED COURSE CONTENTS

Unit	Major Learning Topics and Sub-topics	Outcomes (in cognitive domain)
UNIT– I INTRODUCTION TO DIRECT STRESS & STRAIN	1a. Evaluate Material Properties Under Longitudinal , Lateral Loads & Thermal variation. 1b. Analyse Composite & Compound Section for stress& strain.	1.1 Different types of Structures and Loads 1.2 Direct Stress , linear Strain , Hook's Law Calculate Numerical on Direct Stress & Linear Strain , Stress Strain curve of Mild Steel , Modulus of Elasticity ,Yield , Breaking & Ultimate Stress and factor of Safety. 1.3 Lateral Strain and Poission's ratio.

	1c. Compute Strain Energy under Different Types of Loading on elements.	1.4 Temperature Stresses & Strain with & without yielding. 1.5 Shear Stress , Shear Strain & Shear Modulus. 1.6 Bulk Modulus & Volumetric Strain. 1.7 Differentiate Sudden , Gradual & Impact Load Strain Energy & Proof Resilience for Sudden ,Gradual & Impact Load with Numerical Problems.
UNIT– II MOMENT OF INERTIA	2. Compute Moment of Inertia of Symmetric & asymmetric structural sections	2.1 Moment of Inertia & its Importance. 2.2 Parallel & Perpendicular Axis Theorem. 2.3 Formula of Moment of Inertia of solid & Hollow sections like Rectangle , Triangle , Circle. 2.4 Moment of Inertia about C.G for I section , H section , Channel Section , Angle Section , T Section and Built up Section having flange plates to I & H Section and of Double Channels back to back & toe to toe.
UNIT– III S.F & B.M IN BEAM	3. Draw Shear Force & Bending Moment Diagram for Statically Determinate Beams.	3.1 Statically Determinate Beams Like Cantilever , Simply Supported & Over Hang Beam 3.2 Relation between Shear Force and Bending Moment 3.3 Sagging & Hogging Bending Moment and its importance 3.4 Point of Contra flexure & its importance 3.5 S.F & B.M Diagram for Cantilever , Simply Supported & Over Hang Beam elements like shaft , axle , spindle subjected to Point Load and/ or U.D.L.
UNIT– IV BENDING STRESSES IN BEAM	4 Use ' Theory of Bending' to compute stresses in Beams.	4.1 Bending Theory Equation Bending stress , Sectional Modulus , Neutral Axis Application of Bending theory to Statically determinate beams elements like shaft , axle, spindle , pulley arm having rectangular or circular section to find out stresses.
UNIT– V DEFLECTION OF BEAMS	5. Determine deflection induced in Statically Determinate Beams.	5.1 Slope & Deflection 5.2 Formulae for Cantilever Beam subjected to Point Load at free end and with full UDL. 5.3 Formulae for S.S Beam subjected to Point Load at MID SPAN and with full UDL 5.4 Numerical problems on Slope and Deflection for 5.2 & 5.3
UNIT – VI COLUMNS & STRUTS	6. Calculate Load carrying capacity of Column & Strut.	6.1 Column & Strut. 6.2 Short & Long Column. 6.3 End Condition of Column and effective Length of Column & Modes of Failure in Column. 6.4 Radius of Gyration , Slenderness Ratio. 6.5 Euler's Crippling Load & its numerical 6.6 Rankin's load / Buckling Load of Column /

		screw of screw jack & its numerical.
Unit – VII COMBINED DIRECT & BENDING STRESSES	7. Analyse Structural components subjected to Axial Eccentric Loads	7.1 Eccentricity. 7.2 Formula for combined Direct &Bending Stresses 7.3 Limit of Eccentricity. 7.4 Core section for Rectangular & Circular (Hollow & Solid) 7.5 Numerical on Combined Stresses for Rectangle & Circular Section
Unit – VIII TORSION	8.1 Analyse Machine Components subjected to Torsion for torsional stress 8.2 Calculate Power Transmitted by Shaft , spindle and axle subjected to Torsion.	8.1 Torsion , Angle of Twist , Polar Moment of Inertia , Torsional Rigidity. 8.2 Formula of Torsional Stress. 8.3 Formula for Power Transmitted Consumed for shaft , spindle and axle of solid and hollow sections subjected to Torsion. 8.4 Numericals based on 8.2 & 8.3.

5. SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	INTRODUCTION TO DIRECT STRESS & STRAIN	08	02	04	08	14
II	MOMENT OF INERTIA	04	02	00	04	06
III	S.F & B.M IN BEAM	07	02	04	08	14
IV	BENDING & SHEAR STRESSES IN BEAM	05	02	02	06	10
V	DEFLECTION OF BEAM	04	02	00	04	06
VI	COLUMN & STRUT	04	02	00	04	06
VII	COMBINED DIRECT & BENDING STRESSES	05	02	06	00	08
VIII	TORSION	05	02	00	04	06
TOTAL		42	16	16	38	70

Legends: R = Remember **U**= Understand; **A**= Apply and above levels (Bloom's revised taxonomy).

6. SUGGESTED LIST OF EXERCISES/PRACTICALS.

The tutorial exercises should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the above mentioned competencies.

SR. NO.	UNIT NO.	EXPERIMENT
1	I	Draw Stress Strain Curve for Tension Test on Ductile Materials like Mild Steel , Aluminum
2	I	Determine Young's Modulus of wire of Given Material.
3	II	Calculate Moment of Inertia of Fly Wheel
4	VI	Demonstrate End Conditions of Column.
5	I	Calculate at least Six Problems of Unit - I

6	III	Calculate at least Six Problems of Unit – III
7	VII	Calculate at least Six Problems of Unit – VII
8	VIII	Calculate at least Six Problems of Unit – VIII

7. SUGGESTED LEARNING RESOURCES.

A. List of Books:

SR. NO.	TITLE OF BOOK	AUTHOR	PUBLICATION
1.	Strength of Material	Sramamurthan	Dhanpat Rai
2.	Strength of Materials	S.S. Bhavikatti	Vikas Publshing
3.	Theory of Structures	R S Khurmi	S.Chand & Co.Ltd

B. List of Major Equipment/ Instrument

1. Universal testing machine
2. Searl's apparatus to find young's modulus
3. Working model of end conditions of column
4. Fly wheel

C. List of Software/Learning Websites

1.nptel.iitm.ac.in/courses/.../IIT.../lecture%2023%20and%2024.htm

2. en.wikipedia.org/wiki/Shear_and_moment_diagram

3. www.freestudy.co.uk/mech%20prin%20h2/stress.pdf

4. www.engineerstudent.co.uk/stress_and_strain.html

5. https://www.iit.edu/arc/workshops/pdfs/Moment_Inertia.pdf

8. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnic.

- **Prof. ANKIT PATEL**, H.O.D., Aeronautical Dept. Parul institute of Engg. & tech-Diploma studies.
- **Prof. REENA CHOKSI,** H.O.D. Civil Engg. Dept. Parul institute of Engg. & tech-Diploma studies.
- **Prof. KARNAIL SAINI**, Lecturer. Aeronautical Dept. Parul institute of Engg. & tech-Diploma studies.

Coordinator and Faculty Members from NITTTR_Bhopal.