GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

Course Title: Strength of Material (Code: 3331904)

Diploma Programme in which this course is offered	Semester in which offered
Mechanical/ Mechatronics	THIRD

1. RATIONALE

We have already studied the external effects due to action of force system in Applied Mechanics in Second Semester. All Mechanical Engineering Components are subjected to different loadings and behave in a specific way. In this course , analysis of determinate structures / components under action of transverse loading , along with , analysis of members under direct and lateral along with shear loading & torsion is analysed. This course will lay sound foundation to analysis & design of Machine Components.

2. COMPETENCY

1. Understand the behaviour and analyse Statically Determinate structure like beam , Column & Shaft under static loads & twisting moments
2. Calculate the machine material properties & dimension of machine component due to direct & lateral loading and due to deflection.

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	
03	00	02	05	70	30	20	30	**150**

Legends: L - Lecture; **T -** Tutorial/Teacher Guided Student Activity; **P -** Practical; **C -** Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

4. COURSE DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I **DIRECT STRESS & STRAIN**	1a. Evaluate Material Properties Under Longitudinal , Lateral Loads & Thermal variation 1b. Analyse Composite & Compound Section for stress& strain. 1c. Compute Strain Energy under Different Types of Loading on elements.	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 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 D raw 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 , Nutral Axis Application of Bending theory to Statically determinate beams elements like shaft , axle , spindle , pulley arm having

Unit	Major Learning Outcomes	Topics and Sub-topics
		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 **PRINCIPAL PLANE & PRINCIPAL STRESS**	8. Calculate Principal Stresses on a plane in a Strained structural Material	8.1 Formulae for Normal , Tangential & Resultant Stresses due to Direct Orthogonal Stresses & Shear Stress 8.2 Numericals on Principal Plane & Principal Stress 8.3 Formulae for Principal Stresses and for Location of Principal Planes 8.4 Numerical based on 8.3
Unit – IX **TORSION**	9a. Analyse Machine Components subjected to Torsion for torsional stress 9b. Calculate Power Transmitted by Shaft , spindle and axle subjected to Torsion	9.1 Torsion , Angle of Twist , Polar Moment of Inertia , Torsional Rigidity 9.2 Formula of Torsional Stress 9.3 Formula for Power Transmitted / Consumed for shaft , spindle and axle of solid and hollow sections subjected to Torsion 9.4 Numericals based on 9.2 & 9.3
Unit – X **MECHANICAL PROPERTIES OF MATERIALS**	10a. Identify various materials used in Mechanical Engineering 10b. Evaluate Mechanical Properties of Materials used	10.1 Various Mechanical Engineering Materials 10.2 Specifications of materials in accordance to BIS , ASME 10.3 Test Mechanical Properties like HARDNESS , IMPACT

Unit	Major Learning Outcomes	Topics and Sub-topics
		10.4 Compare materials with their utility point of view

6 SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**DIRECT STRESS & STRAIN**	08	02	04	08	14
II	**MOMENT OF INERTIA**	04	01	00	04	05
III	**S.F & B.M IN BEAM**	05	02	00	08	10
IV	**BENDING & SHEAR STRESSES IN BEAM**	05	04	00	06	10
V	**DEFLECTION OF BEAM**	04	00	00	04	04
VI	**COLUMN & STRUT**	03	00	00	04	04
VII	**COMBINED DIRECT & BENDING STRESSES**	04	01	06	00	07
VIII	**PRINCIPAL PLANE & PRINCIPAL STRESS**	04	02	05	00	07
IX	**TORSION**	03	01	00	04	05
X	**MECHANICAL PROPERTIES OF MATERIALS**	02	00	04	00	04
Total		**42**	**13**	**19**	**38**	**70**

7 SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills so that students are able to acquire the competency. Following is the list of experiments for guidance.

S. No.	Unit No.	Practical/Exercise	Apprx. Hrs. Required
1	I	Draw Stress Strain Curve for Tension Test on Ductile Materials like Mild Steel , Aluminium	04
2	I	Determine Young's Modulus of wire of Given Material	02

S. No.	Unit No.	Practical/Exercise	Apprx. Hrs. Required
3	II	Calculate Moment of Inertia of Fly Wheel	02
4	VI	Demonstrate End Conditions of Column	02
5	X	Calculate Impact Value of Mild Steel using IZOD Impact Test Apparatus	02
6	X	Calculate Impact Value of Mild Steel using Charpy Impact Test	02
7	X	Calculate Brinell Hardness Number of given material	02
8	X	Calculate Hardness of given material using Rockwell Hardness machine	02
9	X	Find out Compressive Strength of C.I , M.S using Compression Testing Machine	02
10	I	Calculate at least Six Problems of Unit - I	02
11	III	Calculate at least Six Problems of Unit – III	02
12	VII	Calculate at least Six Problems of Unit VII	02
13	VIII	Calculate at least Six Problems of Unit VIII	02
		TOTAL	**28**

8 SUGGESTED LIST OF STUDENT ACTIVITIES

1. Market Survey specific to properties of Various type of Materials used in Mechanical Engineering
2. Student will prepare file based on practical

8. SUGGESTED LEARNING RESOURCES

(A) List of Books:

S. No.	Title of Books	Author	Publication
1.	Strength of Material & Mechanics of Structures	Dr. B C Punamia	
2.	Strength of Material	S RAMAMURTHAN	
3.	Strength of Material	TimoShanku	
4.	Theory of Structures	R S KHURMI	

B. List of Major Equipment/Materials

1. Universal Testing Machine

2. SEARL'S Apparatus to find Young's Modulus

3. Working Model of End Conditions of Column

4. IZOD Impact Test Apparatus

5. CHARPY Test Apparatus

6. FLY WHEEL

7. Compression Testing Machine

8. Brinell Hardness Testing Machine

9. Rockwell Hardness Testing Machine

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

9. INSTRUCTIONAL STRATEGICS:

Teachers can prepare or download ppt of different topic's Mechanical engineering application , can prepare alternative slides.

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

1. PROF. B G RAJGOR , H.O.D , APP. MECH. , BBIT , V V NAGAR
2. PROF. K VENKATESHWARLU , H.O.D , APP. MECH. , TFG POLYTECHNIC , ADIPUR
3. PROF. J H GABRA , I/C H.O.D , APP. MECH. , G.P , GODHARA
4. PROF D R KATARIYA , LME , G.P , BHUJ

Coordinator and Faculty Members from NITTTR Bhopal

1. Dr. A K JAIN , PROFESSOR , DEPARTMENT OF CIVIL & ENVIORNMENT ENGINEERING