MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

MUST KNOW CONCEPTS

MKC

CIVIL

2020-21

Course code & Course Name : 19CED02 & Mechanics of Solids

Year/Sem/Sec : II/III

S.NO	Term	Notation (Symbol)	Concept/Definition/Meaning/Units/Equation/Expression	Units
UNIT I STRESS AND STRAIN				
1	Strain	e	Change in length by original length when load is applied (dL/L) dL = pL/Ae	No Unit
2	Young's Modulus	E	Stress/Strain	N/mm^2
3	Bulk modules	K	Stress /Volumetric strain $K=\sigma/e_v$	N/mm^2
4	Poisson's ratio	μ	Lateral or secondary strain / linear or primary strain = 1/m	No unit
5	Volumetric strain	e_v	Change in volume / original volume dv/v	No unit
6	Relationship b/w young's and Bulk modulus	-	E=3K(1-2/m)	N/mm^2
7	Modulus of rigidity	G, N or G	Ratio of shear stress to shear strain τ/e_s	N/mm^2
8	Longitudinal strain	e	Stress/ young's modulus $e= \sigma/E$	No unit
9	Compressive stress	σ	Compressive load / Area= P/A	N/mm^2
10	Thermal strain	e	A actual expansion allowed/ original length $(\alpha TL-s)/L$	No unit
11	Thermal stress	σ	Thermal strain X Young's modulus $\sigma =((\alpha TL-s)/L) X E$	N/mm^2
12	Tensile strain	e_l	The Increment of length to its actual length $e_l = \partial L/L$	No unit
13	Lateral strain	e_t	Change in breadth (depth)/Original breadth (depth) **(**∂**b**/b or ∂**d**/d)	No unit

14	Strain energy	U	The strain energy stored by the body within elastic limit $U = \sigma^2 v/2E$	Nm or J
15	Proof resilience	U_p	$U = \sigma_p^2 v/2E$	Nm or J
16	Modulus of resilience	-	Proof resilience per unit volume($\sigma_p^2 /2E$)	Nm or J
17	Stress	σ	Load/Area	N/mm^2
18	Types of strain	e	Tensile, Compressive , Volumetric and Shear strain	No unit
19	Types of stress	σ	1.Normal stress 2. Shear stress	N/mm^2
20	Elasticity	-	The body tends to undergo deformation	-
21	Hooke's Law	-	Stress is directly proportional to strain within elastic limit	-
22	Factor of saftey	-	Ultimate stress/ Permissible stress	-
23	Poisson's ratio	μ	Lateral strain/Longitudinal strain	-
24	Relation between E & C	-	$C = E/2(1+ \mu)$	N/mm^2
25	Volumetric strain	δv	δv /v	mm^3
UNIT II SHEAR AND BENDING IN BEAMS				
26	Shear force	F	Algebraic sum forces acting on one side of the section or other section	N
27	Beam	-	Beam is a structural member which is supported along the length and subjected to external loads acting transversely .	-
28	Bending moment for point load	M	Load X distance	N-M
29	Bending moment for udl	M	Load X Distance X Distance/2	N-M
30	Moment of Inertia for rectangular	I	$I=bd^3/12$	Mm^4
31	Bending moment equation	M	$M/I= \sigma_b /y =E/R$	N-M

32	Section modules	Z	$Z=I/y$	mm^3
33	Moment of resistance	M	$M= \sigma_b X z$	N-mm
34	Maximum bending stress	σ_b max	$(M_{max}/I) X y$	N/mm^2
35	Section modules of rectangular	Z	$Z=bd^2/6$	mm^3
36	Bending Moment	M	Algebraic sum of moments	Nm
37	Cantilever beam	-	A beam is fixed at one end and other end is free	-
38	Simply supported beam	-	A beam which it has simply supported at both the ends	-
39	Overhanging beam	-	A beam extends beyond the supports	-
40	Fixed beam	-	A Beam which is fixed at both the ends	-
41	Continuous beam	-	A beam which it has more than two supports	-
42	Types of Loading	-	Point Load, UDL , UVL	-
43	Point Load	-	A Load which is acting at an single point in a beam	-
44	UDL	-	A Load which it is distributed uniformly throughout the beam	-
45	UVL	-	A Load which varies along the length of the beam	-
46	Types of supports	-	Roller support , Pinned support, Fixed Support	-
47	Point of Contraflexure	-	Point at which BM changes sign +ve to -ve	-
48	Sagging BM	-	Moment on left side of beam is clockwise or right side is anticlockwise	-
49	Hogging BM	-	Moment on left side of beam is anticlockwise or right side is clockwise	-
50	Maximum BM	-	The shear force changes of sign or the shear force is zero	-
UNIT III DEFLECTION				
51	Moment of inertia of circular	I	$\Pi d^4/64 = I$	mm^4

	section			
52	Moment of Inertia of hollow circle	I	Π (D^4-d^4)/64	mm^4
53	Section Modulus of triangle	Z	Z_{AB} =bh^3/4	N/mm^2
54	Section modulus of 'I' section	Z	Z=BD^3-bd^3/6D	N/mm^2
55	Moment area method of slope	ϴ	1/EI X Area of BM diagram	radians
56	Moment area method of deflection	y	1/EI $\bar{X}$x X Area of BM diagram	mm2
57	Deflection	y	Y=EI.y	mm
58	Slope	ϴ	EI. dy/dx = ϴ	radians
59	Bending moment	M	EI. d^2y/dx^2 =M	N-M
60	Shear force	F	EI. d^3y/dx^3 =F	N
61	The rate of loading	W	W=EI. d^4y/dx^4	KN
62	Area for rectangular	A	A=LX b (Multiplication of length and breadth)	m^2
63	Area for triangular section	A	A=1/2 X b X h (Multiplications of half of the length and breadth)	m^2
64	Rectangular moment of inertia	I	A=bd^3/12	mm^4
65	Methods for Slope & Deflection	-	1. Double integration method 2. Moment area method 3. Macaulay's method	-
66	Slope for Simply supported P.L	ϴ	$ϴ_A$ = $ϴ_B$ = WL^2/16EI	radians
67	Deflection for simply	y	Y = WL^3/48EI	mm

	supported P.L			
68	Slope for UDL	Θ	$\Theta = WL^2/24EI$	radians
69	Deflection for UDL	y	$y = 5/384*WL^3/EI$	mm
70	Moment of Inertia	I	The sum of the products of the mass of each particle in the body with the square of its distance from the axis of rotation	mm^4
71	Structure	-	The arrangement of and relations between the parts or elements	-
72	Point load	p	The load applied to a single point	KN
73	Uniformly distributed load	udl	A load that is distributed or spread across the whole region of an element	KN
74	Uniformly varying load	uvl	The rate of loading varies from each point along the beam	KN
75	Columns	-	A structural element that transmits, through compression	-
UNIT IV PRINCIPAL STRESS AND STRAIN & ANALYSIS OF PLANE TRUSS				
76	Maximum shear stress	$(\sigma_t)max$	Shear stress will be maximum on two planes inclined at 45° and 135° to the section	N/mm^2
77	Principal planes	-	The planes which have no shear stress are known as principle planes	-
78	Mohr's circle	-	Finding out the normal shear stresses on any interface of an element subjected to perpendicular line	-
79	Truss	-	It is defined as a structure, made up of several bars, riveted or welded	-
80	Principal stresses	-	Normal stresses across these planes are termed as principal stress	-
81	Deficient frame	-	One in which the number of members (n)are less than (2j-3)	-
82	Redundant frame	-	One in which the number of members (n) more than (2j-3)	-
83	Imperfect frame	-	One which does not satisfy n=2j-3	-
84	Cantilever trusses	-	A truss which is connected to a well at one end and free at the other end.	-
85	Principal Plane	-	The Planes which have no shear stress	-
86	Determinate Structures.	-	The structures can be solving using conditions of equilibrium alone. No other conditions are required	-

87	Indeterminate Structures.	-	The structures cannot be solving using conditions of equilibrium alone and additional conditions are required	-
88	Slopes	(θ)	Angular shift at any point of the beam between the no-load condition and loaded beam	Rad
89	Deflections	δ	The degree to which a structural element is displaced under a load	mm
90	Plane frame	-	The structures constructed with straight elements connected together by rigid and/or hinged connections	-
91	Rigid joined frame	-	The load-resisting skeleton constructed with straight or curved members interconnected by mostly rigid connections	-
92	Pin joined frame	-	Generally, transfer the applied loads by inducing axial tensile or compressive forces in the individual members	-
93	Portal frame	-	A rigid structural frame consisting essentially of two uprights connected at the top by a third member	-
94	Moment at a hinged end of a simple beam	-	Zero	-
95	Unknown moments are expressed in terms of	-	Slopes (θ) and Deflections (Δ)	-
96	M - θ relationship for a simply supported beam	-	$M / EI = 4\theta$	-
97	Trussed Beam	-	A beam strengthened by providing ties and struts	-
98	Plane strain	-	Normal strain and shear strain directed perpendicular to the plane of body is assumed to be zero	-
99	Plane stress	-	Plane stress exists when one of the three principal stresses is zero	-
100	Maximum shear stress	τ	$\sigma_1 - \sigma_2 \; /2$	N/mm^2
UNIT V TORSION OF SHAFTS AND SPRING				

101	Torsional equation	-	$T/J = \frac{\tau}{R} = \frac{C\theta}{L}$	-
102	Polar modulus	Z_p	It is the ratio between polar moment of inertia and radius of shaft (Zp=J/R)	-
103	Stiffness	K	Stiffness of the spring is load required to preclude unit deflection $K= cd^4/64R^3n$	N/mm
104	Power transmitted by shaft	P	$P=\frac{2\Pi NT}{60X1000}$	Nm
105	Torque transmitted by shaft	T	$T= \tau \times \frac{\Pi}{16}((D^4 - d^4)/D)$	-
106	Helical spring shear stress	τ	$T = \frac{16WR}{\Pi d^2}$	N/mm^2
107	Helical spring Energy stored	U	$U = (\sigma b^2/8E)$ X Volume of spring wire	Nm
108	Stiffness coefficient k_{ij}.	-	The force developed at joint 'i' due to unit displacement at joint 'j' while all other joints are fixed	-
109	Basic equations of stiffness matrix	-	Equilibrium forces, Compatibility of displacements, Force displacement relationships	-
110	Stiffness matrix method	-	The displacements that occur in the structure are treated as unknowns	-
111	Stiffness	k	Resistance offered by member to a unit displacement or rotation at a point	N/m
112	Stiffness factor	k	Moment required to rotate the end while acting on it through a unit rotation	N/m
113	Force	F	The push or pull on an object with mass that causes it to change velocity (to accelerate)	KN
114	Shaft	-	Equal and opposite torques are applied at the two end of the shaft	-
115	Torque	T	Product of force and radius of the shaft	Nmm
116	Power	P	$T * \omega$	KW
117	Types of springs	-	Leaf Spring, Helical Spring	-
118	Laminated Spring	-	To absorb shocks in railway wagons	-
119	Helical spring	-	Thick spring wires coiled into a helix	-

120	Types of Helical spring	-	Closed coiled spring, Open coiled spring	-
121	Deflection of spring	δ	$\delta = 64WR^3n/Cd^4$	mm
122	Stiffness of spring	s	$Cd^4/64WR^3n$	N/mm
123	Spring index	C	Ratio of mean diameter to diameter of wire	-
124	Solid length	-	The length of the spring under maximum compression	-
125	Function of spring	-	1.To measure forces , 2. To store energy	-

Placement Questions				
S.No	**Term**	**Notation (Symbol)**	**Concept/Definition/Meaning/Equation/ Expression**	**Units**
126	Sum of distribution factors at a join	-	1	-
127	In the displacement method of structural analysis, the basic unknowns are	-	Displacements	-
128	The number of simultaneous equations to be solved in the slope deflection method, is equal to	-	The number of joints in the structure	-
129	*M* - θ relationship for a simply supported beam	-	$M/EI = 4\theta$	-
130	The slope of the elastic curve at the free end of a cantilever beam	θ	$WL^3/6EI$	Rad
131	Formula for Speed	s	Distance / Time	m/sec
132	Formula for Time	t	Distance / Speed	sec
133	Formula for Distance	d	Speed x Time	m
134	Area of triangle	A	(Base × Height) / 2	m^2
135	What is the area of a triangle with base 5 meters and height 10 meters?	A	25	m^2

136	Sum of the shape function is equal to	s	1	-
137	Top most part of an arch is called	-	Crown	-
138	Shape of three hinged arch is always	-	Parabolic	-
139	Degree of indeterminacy of a fixed arch	D.O.I	3	-
140	Degree of indeterminacy of a two hinged arch	D.O.I	2	-
141	Degree of indeterminacy of a three hinged parabolic arch	D.O.I	0	-
142	Avera ge	-	Sum of observations / Number of observations	-
143	Specific Gravity of water	G	1	-
144	Density of aggregate	ρ	1200-1750	kg/m^3
145	Density of Concrete (R.C.C)	ρ	2500	kg/m^3
146	Density of Concrete (P.C.C)	ρ	2400	kg/m^3
147	The density of steel is in the range of	ρ	7750 and 8050	kg/m^3
148	Flexural Rigidity		E x I	$N.m^2$
149	The process of subdividing the given body into a number of elements is called	-	Discretization	-
150	A numerical technique for solving boundary value problems is	-	Finite element method	-

Faculty Team Prepared **Signatures**

1. **M.Sanchaya**

HoD