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	2021-22

Course Code & CourseName : 19CEC02 / Strength of Material

Year/Sem/Sec : II/IV/-

S.No	Term	Notation (Symbol)	Concept/Definition/Meaning/Units/Equation/Expression	Units
			Unit I - Energy Principles	
1	Strain	e	Change in length by original length when load is applied (dL/L)	No Unit
2	Young's Modulus	E	Stress/Strain E= pL/Ae	N/mm^2
3	Resilience	-	The strain energy stored by the body within elastic limit, when loaded externally is called Resilience.	-
4	Proof Resilience	-	The Maximum strain energy stored in a body is known as proof resilience.	-
5	Modulus of resilience	-	The proof resilience of a body per unit volume is known as modulus of resilience.$\sigma_p^2/2E$	N/mm^2
6	Strain energy	-	The energy stored in a body due to straining effect is known as strain energy $U=\sigma^2 v/2E$	-
7	strain energy due to axial loads	U	$U = \int \frac{P^2}{2AE} dx$ limit 0 to L	-
8	strain energy due to bending	-	$U = \int \frac{M^2}{2EI} dx$ limit 0 to L	-
9	strain energy due totorsion	-	$U = \int \frac{T^2}{2GJ} dx$ limit 0 to L	-
10	State Maxwel reciprocal theorems	-	$\delta D = \delta E$	-
11	castigliano's first theorem	-	$\partial U/\partial P = \delta$	-
12	castigliano's second theorem	-	$\partial U/\partial \delta = P$	-

13	strain energy (if M is known)	U	$U = M^2L/2EI$	-
14	strain energy (if T is known)	U	$U= T^2L/2GJ$	-
15	strain energy (if applied tension)	U	$U=P^2L/2AE$	-
16	Strain energy density	-	The strain energy per unit volume is called the strain energy density	-
17	Computation of deflections in structures	-	Moment area method	-
18	State the principle of virtual work for deformed body	-	The total work done during a small displacement will be equal to zero	-
19	Williot diagram	-	Williot diagram is the graphical representation to determine the displacements of the joints of the truss.	-
20	Degrees of freedom	-	The number of independent translation and rotation available in a structure is also called as degree of freedom.	-
21	Equilibrium equations	-	$\Sigma H=0$, $\Sigma V=0$, $\Sigma H=0$.	-
22	Use of strain energy in structural analysis	-	To determine the amount of work done by the external forces to produce the deformation	-
23	virtual force	-	Principle of virtual force enable us to determine real displacement.	-
24	Moment of Inertia for rectangular	I	$I=bd^3/12$	Mm^4
25	Bending moment equation	M	$M/I= \sigma_b /y =E/R$	N-M
Unit II - Indeterminate Beams				
24	Determinate Structure	-	Equilibrium conditions are sufficient to analyze the structure	-
25	Indeterminate structure	-	Equilibrium condition alone not sufficient to analyze the structure	-
26	virtual displacement		principle of virtual displacement will enable us to determine real force	-
27	Perfect frame	-	The frame should satisfy m=2j-r	-

28	degree of indeterminacy of 2 D trusses	-	Degree of indeterminacy of 2D trusses =m-2j+r	-
29	Beam	-	Beam is a structural member which is subjected to external loads acting transversely	-
30	Statically determinate structures	-	Conditions of equilibrium are sufficient to analyze the structure	-
31	Statically indeterminate structures	-	Conditions of equilibrium are insufficient to analyze the structure	-
32	Continuous beam	-	A continuous beam is one, which is supported on more than two supports.	-
33	The advantages of continuous beam over simply supported beam	-	The maximum bending moment in case of continuous beam is much less than in case of SSB	-
34	Shear modulus	-	The ratio of shear stress to shear strain is called as bulk modulus	-
35	Flexural rigidity of Beams	-	The product of young's modulus (E) and moment of inertia (I) is called flexural rigidity (EI) of beams The unit is Nmm^2	-
36	Fixed beam	-	A beam whose both ends are fixed is known as a fixed beam.	-
37	The advantages of fixed beams	-	For the same loading, the maximum deflection of a fixed beam is less than that of a simply supported beam	-
38	The disadvantages of a fixed beam	-	Large stresses are setup by temperature changes and if a little sinking of one support takes place	-
39	Bending moment for point load	M	Load X distance	N-M
40	Bending moment for udl	M	Load X Distance X Distance/2	N-M
41	Moment of Inertia for rectangular	I	$I=bd^3/12$	Mm^4
42	Bending moment equation	M	$M/I= \sigma_b /y =E/R$	N-M

43	Section modules	Z	$Z=I/y$	mm^3
45	Section modules of rectangular	Z	$Z=bd^2/6$	mm^3
46	Moment of inertia of circular section	I	$\Pi d^4/64 = I$	mm^4
47	Moment of Inertia of hollow circle	I	$\Pi (D^4-d^4)/64$	mm^4
48	Section Modules of triangle	Z	$Z_{AB} = bh^3/4$	N/mm^2
49	Section modules of 'I' section	Z	$Z=BD^3-bd^3/6D$	N/mm^2
50	Deflection of a fixed beam with eccentric point load	-	$\square = - wl^3/192 EI$	-
UNIT III COLUMNS AND CYLINDER				
54	Column	-	A column is a vertical member subjected to an axial compressive load and fixed rigidly at both ends.	-
55	Types of columnfailure	-	Crushingfailure, Bucklingfailure:	-
56	Strut	-	A strut is a member or slender bar in any position other than vertical, subjected to a compressive load and fixed rigidly	-
57	Unsupported length(l)	-	The unsupported length or actual length (l) of a column or strut is the clear distance between the end restrains	-
58	Effective length(l_e)	-	The distance between adjacent points of inflexion is called effective length or equivalent length	-
59	Radius of gyration	-	$K^2=I/A$	-
60	Slenderness ratio	-	Slenderness ratio = Unsupported length/ Least radius of gyration	-
61	Buckling factor	-	It is the ratio between the equivalent length of column to the minimum radius of gyration(L_e/k)	-

62	Buckling load	-	The maximum limiting load at which the column tends to have lateral displacement	-
63	Factor of safety	-	The ratio between the ultimate load to the permissible load	-
64	Safe load	-	It is obtained by dividing the buckling load by a suitable factor of safety (FOS) Safe load= Buckling load/ Factor of safety	-
65	Short column	-	L< 8d or slenderness ratio less than 32 are called short column.	-
66	Medium column	-	L< 8d < 30 or slenderness ratio more than 120 are called Medium columns	-
67	Long column	-	L>30 or slenderness ratio more than 120 are called columns.	-
68	Assumptions made in the Euler's theory of long column	-	The material of the column is homogeneous, isotropic and elastic. column is uniform throughout.	-
69	Limitatins of the Euler's theory	-	It takes no account of direct stress.	-
70	factors affect the strength column	-	Slendernessratio,End conditions	-
71	Euler's formula for Both ends fixed	-	$P_E = л^2 EI/(0.5L)^2$	KN
72	Euler's formula for Both ebds Hinged	-	$P_E = л^2 EI/L^2$	KN
73	Euler's formula for one end fixed one end hinged	-	$P_E = л^2 EI/(0.7L)^2$	KN
74	Equivalent length of the column	-	The distance between the adjacent points of inflexion is called effective length or equivalent length	-
75	Rakine's formula	-	$P_{R=} \frac{f_C A}{(1+ a (l_{eff} / r)^2)}$	KN
Unit IV - State Of Stress In Three Dimensions				
76	Thin cylinder	-	t < d/20	-
77	Thick cylinders	-	t □ d/20	-

78	Assumptions of lame's theory	-	The material is homogeneous and isotropic The material is stressed within elastic limit	-
79	variation of hoop stress in a thick cylinder	-	The hoop stress is maximum at the inner circumference and minimum at the outer circumference of a thick cylinder	-
80	How can you reduce hoop stress in a thick cylinder	-	The hoop stress in thick cylinders is reduced by shrinking one cylinder over another cylinder.	-
81	Compound cylinders	-	Compound cylinders are thick cylinders shrinking one tube on the other tube to reduce circumferential stress	-
82	Obliquity	ϕ	The angle made by the resultant stress with normal of the reference oblique plane is called as obliquity (ϕ)	-
83	types offailures	-	Brittlefailure, Ductilefailure	-
84	Brittlefailure	-	Failure of a material represents direct separation of particles from each other	-
85	Ductilefailure	-	Slipping of particles accompanied, by considerable plastic deformations	-
86	different theories offailure	-	Maximum Principal Stress Theory,Maximum Principal Strain Theory,Maximum Shear Stress Theory,	-
87	Maximum Principal Stress Theory.	-	$\sigma 1 = f y.$	-
88	Maximum Principal Strain Theory.	-	$e_1 = f_y / E$	-
89	Maximum Shear Stress Theory	-	In3D,$(\sigma_1-\sigma_3)/ 2=f_y/2 \rightarrow (\sigma_1-\sigma_3)=f_y$ In2D,$(\sigma_1 - \sigma_2) / 2 = f_y /2 \rightarrow \sigma_1= f_y$	-
90	Maximum Shear Strain Theory	-	In 3D, $2f_y^2= (1/ 12G)[(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2]$	-

91	Limitations of Maximum Shear Stress Theory	-	It does not give the accurate results for the state of pure shear in which the max. amount of shear is developed	-
92	limitations of Maximum Shear Strain Theory	-	It cannot be applied for the materials under hydrostatic pressure	-
93	limitations of Maximum Strain Energy Theory	-	This theory does not apply to brittle materials	-
94	Principal axes	-	The moment of inertia abut a principal axis is called the Principal moment of inertia	-
95	OctahedralStresses	-	$\tau_{oct} = 1/3 \sqrt{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2}$	-
96	Shear centre	-	It is defined as the point on the beam section where the load is applied and no twisting is produced.	-
97	Assumptions made in the analysis of curved bars	-	Plane sections remain plane duringbending, The material obeys Hooke's law, Radial strain isnegligible	-
98	Bending moment for udl	M	Load X Distance X Distance/2	N-M
99	Moment of Inertia for rectangular	I	$I=bd^3/12$	Mm^4
100	Types of columnfailure	-	Crushingfailure, Bucklingfailure:	-
Unit V - Advanced Topics In Bending Of Beams				
101	Unsymmetrical bending	-	If the bending caused by loads that does not coincident the principal centroidal axis of inertia.	-
102	Symmetrical sections	-	The neutral axis passes through the geometrical centre of the section	-
103	Unsymmetrical sections	-	The neutral axis does not pass through the geometrical centre of the section	-
104	Curved beams	-	A beam in which the neutral axis in the unload condition is curved instead of straight termed as curved beams.	-
105	Assumption of winkler –bach theory	-	Transverse sections which are plane before bending remains plane even after bending	-
106	resultant stress in a curved bar	-	$\square_r = \square_o + \square_b$	-

107	shape of distribution of bending stress in a curved beam	-	The distribution of bending stress is hyperbolic in a curvedbeam	-
108	Where does the neutral axis lie in a curvedbeam	-	The neutral axis does not coincide with the geometric axis.	-
109	What is the nature of stress in the inside section of a cranehook	-	Tensilestress	-
110	Where does the maximum stress in a ring under tensionoccur	-	The maximum stress in a ring under tension occurs along the line of action of load.	-
111	What is the most suitable section for acrane	-	Trapezoidal section	-
112	pure bending of abeam	-	When the loads pass through the bending axis of a beam, then there shall be pure bending of the beam	-
113	principal moment of inertia	-	The moments of inertia with respect to principal axes	-
114	Minor principal moment of inertia	-	The minimum moment of inertia is known as minimum principal moment of inertia	-
115	Crushingfailure	-	The column will be subjected to the ultimate crushing stress, beyond this the column will fail by crushing	-
116	Buckling Failure	-	The load at which the column just buckles is called buckling load or crippling load or critical load.	-
117	Differential for bending moment	M	EI. d^2y/dx^2 =M	N-M
118	reasons for unsymmetricalbending	-	The section is symmetrical but the load line is inclined to both the principalaxes	-
119	stress due to unsymmetricalbending	□	□ = $\frac{Mu.u}{Ivv}$ □ $\frac{Mv.v}{Iuu}$	N/mm^2
120	Area for triangular	A	A=1/2 X b X h (Multiplications of half of the length	m^2

	section		and breadth)	
121	Rectangular moment of inertia	I	$A=bd^3/12$	mm^4
122	Bending moment equation	M	$M/I= \sigma_b /y =E/R$	N-M
123	Section modules	Z	$Z=I/y$	mm^3
124	Section modules of rectangular	Z	$Z=bd^2/6$	mm^3
125	Moment of inertia of circular section	I	$\Pi d^4/64 =I$	mm^4

Placement Questions				
S.No	**Term**	**Notation (Symbol)**	**Concept/Definition/Meaning/Units/ Equation/Expression**	**Units**
126	At the first point of Aeries, the sun moves	-	From south to north of the equator	-
127	According to ICAO, all markings on the runways are	-	White	-
128	The time period of a simple pendulum depends on	-	Mass of suspended particle, Length of the pendulum	-
129	Free body diagram is an	-	Isolated joint with all the forces, internal as well as external, acting on it	-
130	In verandah (corridor) floors outward slope is	-	1 in 60	-
131	Jumper is a tool used for	-	Quarrying of stones	-
132	Diagonal tension in a beam	-	Increases below the neutral axis and decreases above the neutral axis	-
133	Sensitivity analysis is a study of	-	Change in output due to change in input	-
134	The elastic strain for steel is about	-	1/12 of strain at the initiation of strain hardening and 1/200 of maximum strain	-
135	The risk coefficient k, depends on	-	Mean probable design life of structures and Basic wind speed	-

136	column splice is used to increase	-	Length of the column	-
137	photo-interpretation	-	Identification, Recognition of objects, Judging the significance of objects	-
138	Current ratio	-	The ratio of current assets to current liabilities is known as Current ratio	-
139	polluted water	-	Consists of undesirable substances rendering it unfit for drinking	-
140	The plinth area of a building not includes	-	Area of cantilevered porch	-
141	Tyre pressure influences the	-	Quality of surface course	-
142	Steady flow occurs when	-	The velocity of successive fluid particles, at any point, is the same at successive periods of time	-
143	super-sonic flow	-	Mach number is between 1 and 6	-
144	syphon aqueduct	-	Canal passes over the drainage and H.F.L. of the drainage is above the bottom	-
145	The load stress of a section can be reduced by	-	Replacing larger bars by greater number of small bars	-
146	grillage foundation	-	Is provided for heavily loaded isolated columns,	-
147	Angle of friction	-	Angle between normal reaction and the resultant of normal reaction	-
148	The three moments equation is applicable only when	-	There is no discontinuity such as hinges within the span	-
149	The fixed support in a real beam becomes in the conjugate beam a	-	Free end	-
150	Lami's theorem	-	If three forces acting at a point are in equilibrium	-

Faculty Team Prepared **Signature**

1. **Mrs.M.Sanchaya**

HoD