Buddha Institute of Technology

Gorakhpur

Department of Mechanical Engineering

ALLOTMENT BASED ON COMPETENCY SKILLS

Academic Session: 2022-223

Name of the Staff	Mr Vikas Kumar Singh
Area of Specialization	CAD/CAM
Subject Allotted	Strength of Material

Sl. #	Course Code	Course Title	Semester	Theory/Practical
1.	KME502	Strength of Material	V Sem Batch B	Theory

HOD

Course Outcome and Programme Outcome

Program	: B. Tech.
Branch	: ME
Semester	: V
Session	: 2022-23
Name of the Course	: Strength of Material
Code	:KME502
Name of the Course Instructor	: Vikas Kumar Singh
Designation	: Assistant Professor
Department	: Mechanical Engineering

Description of the Course Outcome:

CO	After completion of the course students will be able to:
KME 502	Understand the concept of stress and strain under different conditions of loading
KME 502	Determine the principal stresses and strains in structural members
KME 502	Determine the stresses and strains in the members subjected to axial, bending and torsional loads.
KME 502	Apply the concepts of stresses and strain in solving problems related to springs, column and pressure vessels
KME 502	Calculate the slope, deflection and buckling of loaded members
KME 502	Analyze the stresses developed in straight and curved beams of different cross sections

Buddha Institute of Technology, Gorakhpur			
Department: Mechanical Engineering			
Academic Semester: July – Dec 2022			
Semester: V	Section: B	Course Code: KME502	Course: Strength of Material
Course Instructor: Mr. Vikas Kumar Singh		Contact Hours /week: 06	# of credits: 03
CIE Marks: 50		SEE Marks:100	Exam Hours: 03

Prerequisites if any:

Code No	Course Name	Description	Semester
KME402	Engineering mechanics	Engineering mechanics	IV

Content delivery:	Chalk & Board, DLP, System/Laptop with social media videos

COURSE SYLLABUS:			
ModuleNo	**Contents of Module**	**Hrs**	**COs**
1	**Compound stress and strains:** Introduction, normal stress and strain, shear stress and strain, stresses on inclines sections, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr's circle for plane stress, three dimensional states of stress & strain, equilibrium equations, generalized Hook's law, theories of failure. Thermal Stresses.	**14**	**CO1**
2	**Stresses in Beams:** Pure Bending**,** normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams. **Deflection of Beams:** Differential equation of the elastic curve, cantilever and simply supported beams,Macaulay's method, area moment method, fixed and continuous beams **Torsion:** Torsion, combined bending & torsion of solid & hollow shafts, torsion of thin walled tubes.	**10**	**CO2**
3	**Helical and Leaf Springs:** Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs. **Columns and Struts:** Buckling and stability, slenderness ratio, combined bending and direct stress,middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin ended columns, effect of end conditions on column buckling, Ranking Gordon formula, examples of columns in mechanical equipment and machines.	**11**	**CO3**
4	**Thin cylinders & spheres:** Introduction, difference between thin walled and thick walled pressure vessels, thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain. **Thick cylinders:** Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits.	**10**	**CO4**
5	**Curved Beams:** Bending of beams with large initial curvature, position of neutral axis for rectangular,trapezoidal and circular cross sections, stress in crane hooks, stress in circular rings subjected to tension or compression. **Unsymmetrical Bending:** Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section.	**12**	**CO5**

COURSE OUTCOMES: At the end of the Course, the Student will be able to:

KME502	Understand the concept of stress and strain under different conditions of loading
KME502	Determine the principal stresses and strains in structural members
KME502	Determine the stresses and strains in the members subjected to axial, bending and torsional loads and Calculate the slope, deflection and buckling of loaded members
KME502	Apply the concepts of stresses and strain in solving problems related to springs, column and pressure vessels
KME502	Analyze the stresses developed in straight and curved beams of different cross sections

Mapping of CO v/s PO:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
KME054.1	3	3	3	2	2	–	–	–	–	–	–	2
KME054.2	–	–	2	1	–	2	–	–	–	2	1	2
KME054.3	–	–	2	1	–	–	–	–	–	2	1	2
KME054.4	–	–	3	1	–	2	3	–	–	2	1	2
KME054.5	–	–	2	1	–	1	–	–	–	2	1	2

Correlation levels: 1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)

Mapping of CO v/s PSO:

	PSO1	PSO2
KME502.1	3	3
KME502.2	3	3
KME502.3	3	3
KME502.4	3	3
KME502.5	3	3

Gap in the syllabus	NA

Topics to be covered beyond syllabus	NA

Assessment Methodologies:

Sl. No.	Description	Type
1	Student Assignment	Direct
2	Internal assessment	Direct
3	University exam	Direct
4	Student feedback	Indirect
5	Alumni feedback	Indirect
6	Employers feedback	Indirect

LESSON PLAN

Lecture #	Module #	Topics	RBT Levels	Course Outcome Mapping	Planned Date	Actual Date	Faculty Sign	Remarks
1	1	Introduction to stress	L2, L3, L4	CO1	22/8/22			
2		Normal stress and strain			23/8/22			

3		Shear stresses and strain			24/8/22			
4		Stresses on inclined sections 1-D			25/8/22			
5		Stresses on inclined sections 2-D			26/8/22			
6		**Tutorial**			27/8/22			
7		Numerical			29/8/22			
8		Strain Energy			30/8/22			
9		Impact load and stresses			31/8/22			
10		Plane stress and plane strain			1/9/22			
11		Principle stresses and principle strain			2/9/22			
12		**Tutorial**			3/9/22			
13		Maximum shear stress in a material			5/9/22			
14		Mohr's circle			6/9/22			
15		Mohr's circle cont.			7/9/22			
16		3-D stress and strain			8/9/22			
17		Generalized Hook's law			9/9/22			
18		Tutorial			10/9/22			
19		Theories of failure			12/9/22			
20		Theories of failure cont.			13/9/22			
21		Thermal stresses and strain			14/9/22			
22	2	Pure Banding	**L2, L3, L4**	**CO2**	15/9/22			
23		Normal stresses in beams			16/9/22			
24		Tutorial			22/9/22			
25		Shear stresses in beams due to transverse loads			23/9/22			
26		Shear stresses in beams due to transverse loads cont.			24/9/22			
27		Shear stresses in beams due to axial loads			1/10/22			
28		Shear stresses in beams due to axial loads cont.			3/10/22			
29		Composite beams			6/10/22			
30.		Tutorial			10/10/22			
31.		Differential equation of elastic curve			11/10/22			
32.		Deflection of cantilever beams			12/10/22			
33.		Deflection of cantilever beams cont.			13/10/22			

34.		Deflection of cantilever beams cont.			14/10/22			
35.		Deflection of Simply supported beams beams cont.			15/10/22			
36.		Tutorial			17/10/22			
37.		Deflection of Simply supported beams beams cont.			18/10/22			
38.		Macaulay's method			27/10/22			
39.		Area moment method			28/10/22			
40.		Fixed and continuous beams			29/10/22			
41.		Torsion			31/10/22			
42.		Tutorial			1/11/22			
43.		Combined bending and torsion of solid shaft			7/11/22			
44.		Combined bending and torsion of hollow shaft			8/11/22			
45.		Torsion of thin walled tube			11/11/22			
46.		Spring			12/11/22			
47.		Deflection of spring under axial load			14/11/22			
48.		Tutorial			15/11/22			
49.		Deflection of spring under axial twist			16/11/22			
50.		Deflection of spring under combined loading			17/11/22			
51.		Laminated spring			18/11/22			
52.		Numrical			19/11/22			
53.	**3**	Buckling and stability of column	L2, L4	**CO3**	21/11/22			
54.		**Tutorial**			22/11/22			
55.		Combined bending and direct stresses			23/11/22			
56.		Middle 3rd and quarter rules			24/11/22			
57.		Euler's theory			25/11/22			
58.		Euler's theory cont.			26/11/22			
59.		Rankine Gordon formulae			28/11/22			
60.		**Tutorial**			29/11/22			
61.		Thin cylinders			30/11/22			
62.		Thin cylinders cont.			1/12/22			
63.	4	Thin Spheres	L2.L3	CO4	2/12/22			
64.		Volumetric strain			3/12/22			
65.		Numerical			5/12/22			

66.		**Tutorial**			6/12/22			
67.		Thick cylinders			7/12/22			
68.		Thick cylinders cont.			8/12/22			
70.		Stresses due to interference fits			9/12/22			
71.	**5**	Curved beam	L2	CO5	10/12/22			
72.		Position of nuteral axis			12/12/22			
73.		Stresses			13/12/22			
74.		Unsymmetrical bending			14/12/22			
75.		Stresses in unsymmetrical bendign			15/12/12			

***L1 – Remembering; L2 – Understanding; L3 – Applying; L4 – Analysing; L5 – Evaluating; L6 - Creating**

Literature:

Text Books:

1. Strength of materials by Sadhu Singh, Khanna Book Publishing Co. (P) Ltd.

2. Strength of Material by Rattan, MC GRAW HILL INDIA

3. Mechanics of Materials by B.C. Punmia, Laxmi Publications (P) Ltd.

Reference Books:

1. Mechanics of Materials by Hibbeler, Pearson.

2. Mechanics of material by Gere, Cengage Learning

3. Mechanics of Materials by Beer, Jhonston, DEwolf and Mazurek, MC GRAW HILL INDIA

4. Strength of Materials by Pytel and Singer, Harper Collins

5. Strength of Materials by Ryder, Macmillan.

6. Strength of Materials by Timoshenko and Yσungs, East West Press.

7. Introduction to Solid Mechanics by Shames, Pearson

8. Mechanics of material by Pytel, Cengage Learning

9. An Introduction to Mechanics of Solids by Crandall, MC GRAW HILL INDIA

10. Strength of Materials by Jindal, Pearson Education

11. Strength of Materials by Basavajaiah and Mahadevappa, University Press.

Sample Questions:

Question No.	Questions
1	Mohr's Circle for two like stresses $P_1 \& P_2$. $P_1 \& P_2$.
2	Mohr's Circle construction for two unlike stresses $P_1 \& P_2$. $P_1 \& P_2$.
3	Theory of failures.

4	Mohr's Circle for the general case of plane stress.
5	Differential equation of deflection curve of beam. $M = EI\frac{d^2y}{d^2x}$ $M = EI\frac{d^2y}{d^2x}$
6	Derive an expression for the slope and deflection of a beam subjected to uniform bending moment. $\theta_A = \theta_B = \frac{ML}{2EI}$ $\theta_A = \theta_B = \frac{ML}{2EI}$
7	Explain Macaulay's method
8	Derive an expression for the slope and deflection of a beam subjected to uniform bending moment.
9	Castigliano;s theorem
10	Explain moment area method foe deflection and slop calculation.
11	Torsion equation. $\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{R}$ $\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{R}$
12	Strain energy stored in a body due to torsion
13	Combined bending & torsion
14	Bending equation. $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$ $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$
15	Distribution of shear stresses
16	Shear stress distribution over solid rectangular section
17	Shear stress distribution over triangle section
18	Shear stress distribution over I-section
19	Shear stress distribution over solid circular section
20	$Helical\ spring\ derivation\ \delta = \frac{64WR^3n}{Gd^4}$ $Helical\ spring\ derivation\ \delta = \frac{64WR^3n}{Gd^4}$ and $= \frac{16WR}{\pi d^3}$ $= \frac{16WR}{\pi d^3}$
21	For open coiled with axial load $= 2WR^3n\pi\ sec\ sec \left[\frac{Cos^2\alpha}{GJ} + \frac{Sin^2\alpha}{EI}\right]$ $= 2WR^3n\pi\ sec\ sec \left[\frac{Cos^2\alpha}{GJ} + \frac{Sin^2\alpha}{EI}\right]$
22	For open coiled with axial Thrust $= 2TRn\pi Sec\alpha\left[\frac{Sin^2\alpha}{GJ} + \frac{Cos^2\alpha}{EI}\right]$ $= 2TRn\pi Sec\alpha\left[\frac{Sin^2\alpha}{GJ} + \frac{Cos^2\alpha}{EI}\right]$
23	Discuss Rankine-Gordon formula. $P = \frac{\sigma_c A}{1+\alpha\left(\frac{L_E}{k}\right)^2}$ $P = \frac{\sigma_c A}{1+\alpha\left(\frac{L_E}{k}\right)^2}$
24	$Eulers\ formula\ P = \frac{\pi^2 EI}{L^2}$
25	$P = \frac{\pi^2 EI}{4L^2}$ $P = \frac{\pi^2 EI}{4L^2}$ one end fixed and other end is free
26	$P = \frac{2\pi^2 EI}{L^2}$ $P = \frac{2\pi^2 EI}{L^2}$ one end fixed and other end pinned or hinged
27	$P = \frac{\pi^2 EI}{L^2}$ $P = \frac{\pi^2 EI}{L^2}$ when both ends are fixed
28	hoop stress or maximum Permissible stress or tensile stress $\sigma_C = \frac{Pd}{2t}$ $\sigma_C = \frac{Pd}{2t}$
29	Longitudinal stress $\sigma_L = \frac{Pd}{4t}$ $\sigma_L = \frac{Pd}{4t}$
30	These equations are called Lame's Equations.
31	Determine the hoop stresses in a thick compound cylinder?
32	Derive the expression for the radial pressure and hoop stress for a thick spherical shell?

Assessment rubrics that is going to be adopted for direct attainment is depicted in below table

Level of Achievement	Elaboration on Course Grading Description	Bench Mark Set (Out of 50)
Excellent (A)	The Student's performance is outstanding in almost all the intended course learning outcomes	40 to 50
Good (B)	The student's performance is good in most of the intended course learning outcomes.	30 to 40
Marginal (C)	The student's performance is barely satisfactory. It marginally meets the intended course learning outcomes	20 to 30
Fail (F)	The Students performance is inadequate. Student fails to meet many of the intended course learning outcomes	Less than 20