Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bangalore

	Course Title: **STRENGTH OF MATERIALS**		
	Scheme (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15ME31T**
	Type of Course: **Lectures, Self Study & Quiz**	Credit **:04**	Core/ Elective: **Core**
CIE- 25 Marks			SEE-100 Marks

Prerequisites: Knowledge of basic mathematics and Science.

Course Objectives: It aims at enabling the student to understand & analyze various types of loads, stresses & strains along with main causes of failure of machine parts.

1. The subject is pre-requisite for understanding principles of Machine design.
2. Understanding mechanical properties of materials will help in selecting the suitable materials for various engineering applications

On successful completion of the course, the students will be able to attain CO:

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Understand and distinguish the behavior of simple load carrying members subjected to an axial, shear and thermal Loading.	***R/U/A***	1,2,3,9	**14**
CO2	Interpret the Variation of moment of inertia for different Mechanical Engineering Sections such as fly wheel	***R/U/A***	1,2,4,9	**10**
CO3	Draw and Compare the shear force and bending moment diagram on beams under varying load conditions.	***R/U/A***	1,2,4,9	**12**
CO4	Assess Bending and shear stresses in beams subjected to different loadings for different machine parts	***R/U/A***	1,2	**07**
C05	Differentiate in strain energy stored in a body when the load is suddenly applied and gradually applied	***U/A***	1,2	**03**
C06	Design simple solid and hallow shaft for power transmission keeping view of Environmental and sustainability aspects	***R/A***	1,2,6	**06**
		Total sessions		**52**

Legend: R; Remember, U: Understand A: Application

COURSE-PO ATTAINMENT MATRIX

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
STRENGTH OF MATERIALS	3	3	1	3	-	1	-	-	3	-

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

COURSE CONTENT AND BLUE PRINT OF MARKS FOR SEE

Unit No	Unit Name	Hour	Questions to be set for SEE			Marks weightage	weightage (%)
			R	U	A		
1	SIMPLE STRESSES AND STRAINS	14	05	05	20	30	21
2	MOMENT OF INERTIA	10	05	05	20	30	21
3	SHEAR FORCE AND BENDING MOMENT	12	05	05	20	30	21
4	THEORY OF SIMPLE BENDING	07	05	05	20	30	21
5	STRAIN ENERGY AND IMPACT LOADING	03	-	05	05	10	06
6	TORSION OF CIRCULAR SHAFT	06	05	--	10	15	10
	Total	52	25	25	90	145	100

Legend: R; Remember, U: Understand A: Application

UNITI: SIMPLE STRESSES AND STRAINS 14 Hrs

Simple stresses & strains viz. tensile, compressive, Shear, Crushing, Thermal stresses, & corresponding strains,Hook's Law –Problems on Direct Stress & Linear Strain- Stress- Strain curve for Ductile material and Brittle material with all parameters.- factor of Safety. Elastic Constants - Lateral Strain ,Poisson's ratio, Bulk Modulus, Shear Modulus ,Volumetric Strain-Relation between elastic constants- Problems on elastic constants. Hoop stress-Longitudinal Stress in thin cylindrical & spherical shells subjected to internal pressure.-Problems on thin cylindrical shells.

UNITII: MOMENT OF INERTIA 10Hrs

Centre of Gravity, Moment of Inertia & its Importance -Parallel & Perpendicular Axis Theorem-C.G of Rectangle, Triangle, Circle, Semi-circle, Trapezium, Cone-Problems on

finding CG of T-Section, I-Section, L-Section, Channel-Section. Moment of Inertia of solid &Hollow sections like Rectangle, Triangle, Circle- Moment of Inertia about C.G for I section, T section. L-section and Channel Section.

UNTIII: SHEAR FORCE AND BENDING MOMENT DIAGRAMS 12Hrs

Definition - Shear Force and Bending Moment –Types of beams, types of load acting on beams ,Sagging & Hogging Bending Moment and its importance –sign convention to draw SFD and BMD- Concept of Maximum bending moment, Point of Contra flexure & its importance-Drawing S.F & B.M Diagram for Cantilever, Simply Supported Beams subjected to Point Load and U.D.L

UNIT IV:THEORY OF SIMPLEBENDING 07Hrs

Introduction, assumptions in theory of simple bending.-Bending stress, relation between bending stress & radius of curvature (without proof).-Position of neutral axis, moment of resistance-Bending equation (without proof)-Modulus of section for rectangular, hollow rectangular and hollow circular sections-Beams of uniform Strength-problems

UNIT V: STRAIN ENERGY AND IMPACT LOADING 03Hrs

Introduction -Strain Energy-Types of loading-Sudden, Gradual & Impact Load-resilience, proof resilience and modulus of resilience-Equation for strain energy stored in a body when the load is gradually applied and suddenly applied – problems.

UNIT VI: TORSION OF CIRCULAR SHAFT 06Hrs

Introductionto Torsion , Angle of Twist , Polar Moment of Inertia , Torsion equation-(without proof)-Assumptions in theory of Torsion -Power Transmitted by a shaft, axle of solid and hollow sections subjected to Torsion - Comparison between Solid and Hollow Shafts subjected to pure torsion- Problems. (No problem on composite and non homogeneous shaft)

TEXT BOOKS

1. Ramamurtham. S., *"Strength of Materials",* 14th Edition, Dhanpat Rai Publications, 2011
2. Khurmi R S, *"Applied Mechanics and Strength of Materials",* 5 Edition, S.Chandand company

REFERENCES

1. Popov E.P, *"Engineering Mechanics of Solids",* 2nd Edition, Prentice-Hall of India, New Delhi, 2002.
2. Nash W.A, *"Theory and problems in Strength of Materials",* Schaum Outline Series, McGraw-Hill Book Co., New York, 1995.

3. Kazimi S.M.A, *"Solid Mechanics"*, Tata McGraw-Hill Publishing Co., New Delhi, 2003.
4. Ryder G.H, *"Strength of Materials",* 3rd Edition, Macmillan India Limited, 2002.
5. Bansal R. K, "*Strength of Materials",* Laxmi Publications, New Delhi, 2012.
6. Timoshenko S.P, *"Elements of Strength of Materials",* Tata McGraw-Hill, Delhi,

LIST OF SOFTWARE/LEARNING WEBSITES

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

SUGGESTED LIST OF STUDENT ACTIVITYS

Note: The following activities or similar activities for assessing CIE (IA) for 5 marks (Any one).

1. Each student should do any one of the following type activity or any other similar activity related to the course and before conduction, get it approved from concerned Teacher and HOD.
2. Each student should conduct different activity and no repeating should occur

1	Calculate Moment of Inertia of Fly Wheel of engine present in your laboratory
2	Market Survey specific to properties of Various type of Materials used in Mechanical Engineering and make report
3	Compare the strength of solid shaft with that of hallow shaft for same power transmission for an automobile and make report

Course Delivery:

- The course will be delivered through lectures and Power point presentations/ Video.

- **MODEL OF RUBRICS /CRITERIA FOR ASSESSING STUDENT ACTIVITY**

RUBRICS FOR ACTIVITY(5 Marks)						
Dimension	**Unsatisfactory**	**Developing**	**Satisfactory**	**Good**	**Exemplary**	**Student Score**
	1	**2**	**3**	**4**	**5**	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	Ex: 4
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	5
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	2
					Average / Total marks=(4+5+3+2)/4=14/4=3.5=4	

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned faculty (Course Coordinator) for assessing the given activity.

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
Direct Assessment	CIE	IA	Students	Three IA tests (Average of three tests will be computed)	20	Blue books	1,2,3,4,5,6
				Student activities	05	Report/Log of activity	
	SEE	End Exam		End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course		Students	Middle of the course		Feedback forms	1 & 2,3 Delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of Delivery of instructions & Assessment Methods

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books(20 marks)
2. Student suggested activities report for 5 marks and should be assessed on RUBRICS
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods.

FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th weak of sem 10-11 Am	I/II SEM	Strength of Materials	20
	Year:	Course code:15ME31T	
Name of Course coordinator : CO's:____			Units:__

Question no	Question	MARKS	CL	CO	PO
1					
2					
3					
4					

Note: Internal choice may be given in each CO at the same cognitive level (CL).

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th weak of sem 10-11 Am	III SEM	Strength of Materials	20
	Year: 2015-16	Course code:15ME31T	
Name of Course coordinator :			Units:1, Co: 1,2,3.9

Note: Answer all questions

Question no	Question	CL	CO	PO
1	Explain linear and lateral strain 3 MARKS	U	1	1,2, 3,9
2	A bar of 30mm diameter is subjected to an axial pull of 80KN. The measured extension is 0.1 mm on a gauge length of 200mm and the change in diameter is 0.004mm. Calculate the poison's ratio and the values of young's Modulus, bulk modulus and Modulus of rigidity. 7 MARKS	A	1	1,2, 3,9
3	A mild steel bar of 15mm diameter was subjected to tensile test. The test bar was found to yield at a load of 90KN and it attains maximum	A	1	1,2,

	load of 180KN and ultimately fails at a load of 67.5 KN. Determine the following: tensile stress at the yield point, ultimate stress and stress at the breaking point, if the diameter of the neck is 7.5mm. OR A bar of steel 1m long 50mm wide and 10mm thickness is subjected to an axial load of 10KN in the direction of its length. Find the changes in length, width, thickness and volume.10 MARKS			3,9

MODEL QUESTION PAPER (SEE)

Diploma in Mechanical Engineering

III Semester

Course title: STRENGTH OF MATERIALS

(Answer any 6 questions from part A and Any 7 from Part B)

PART-A(Each questions carries 5 marks)

1. Define bulk Modulus and Shear Modulus
2. Explain thermal stress and Shear Modulus
3. State Parallel and perpendicular axis theorem
4. Locate CG for Triangle Rectangle, Circle, Semi-circle, Trapezium, Cone with the help of plain figure
5. Define Shear force and Bending Moment in beams
6. Explain Point of Contra flexure in a beam
7. List the aassumptions in theory of simple bending
8. Explain Beams of Uniform Strength
9. Explain Strain energy and Resilience

PART-B(Each questions carries 10 marks)

1. A steel rod 30mm x 12.5mm and 500mm long is subjected to a axial pull of 75KN. Determine the changes in length, width and thickness and volume of bar. If young's modulus is 200KN/mm^2.
2. A bar of 30mm diameter is subjected to an axial pull of 80KN. The measured extension is 0.1 mm on a gauge length of 200mm and the change in diameter is 0.004mm. calculate the poisson's ratio and the values of young's Modulus, bulk modulus and Modulus of rigidity.
3. An I section consists of top flange 100 X 30 mm, bottom flange 200 X 40 mm and web 180 X 20 mm. Find the M.I. about an axis passing through C.G. parallel to the base.

4. Calculate M.I. of an angle section 100 X 80 X 10 mm about an axis passing through the centroid and parallel to shorter leg.
5. A cantilever of length 3 m carries a uniformly distributed load of 1.5 KN/m for entire length and a point load of 2 KN at a distance of 1 m from the free end. Draw the shear force and the bending moment diagrams for the beam.
6. A simply supported beam of length 5 m carries point loads of 2 KN and 4 KN and 5 KN at a distance of 1 m, 3 m and 4 m from left support. Draw S.F. and B.M. diagrams for the beam.
7. A steel plate is bent into a circular arc of radius 10m.The plate is 100mm wide and 15mm thick, assuming the value of $E=2X10^5$ N/mm^2.Find the maximum stress induced in the plate and value of bending moment which produced this stress.
8. A simply supported wooden beam of span 1.3 m is carrying a central point load of 40 KN. If the allowable bending stress in the timber is taken as 8 N/mm^2, find the breadth and depth of the timber. Take b=0.6d.
9. (a).List the assumptions made in theory of Torsion -5M

b)An axial pull of 25KN is suddenly applied on a steel rod of 3 m long and $900mm^2$ in cross-sectional area. Calculate the strain energy stored in the rod. Take young's modulus is $2x10^5$ N/mm^2. –5M

10. A solid circular shaft is required to transmit 80KW at 160 rpm. The permissible shear stress in the shaft is 60 N/mm^2.The maximum Torque transmitted exceeds the mean torque by 20% more than mean torque. The angle of twist is not to exceed 10 in a length of 20 times the diameter of the shaft. The valve of rigidity modulus is 0. $8x10^5$ N/mm2.

MODEL QUESTION BANK

Diploma in Mechanical Engineering

III Semester

Course title: STRENGTH OF MATERIALS

CO I: Understand and distinguish the behavior of simple load carrying members subjected to an axial, shear and thermal Loading.

LEVEL: REMEMBER QUESTIONS

1. Define Poisson's ratio and Modulus of Rigidity
2. Define bulk Modulus and Shear Modulus
3. Describe maximum stress and factor of safety

LEVEL: UNDERSTANDING QUESTIONS

4. Explain linear and lateral strain
5. Explain thermal stress and volumetric strain
6. Explain Hoop's stress and longitudinal stress in thin cylindrical shells
7. Explain thermal stress and Shear Modulus

LEVEL: APPLICATION QUESTIONS

8. Relate between elastic constants

9.Draw stress strain diagram for Ductile materials with all parameters

10.Draw stress strain diagram for Brittle materials with all parameters

11..A load of 5KN is to be raised with the help of a steel wire. Find the diameter of the steel wire, if the stress is not to exceed 100MPa.

12.A tensile test is performed on a brass specimen 10mm in diameter using a gauge length of 50mm. When applying axial tensile load of 25KN, it was observed that the distance between the gauge marks increase by 0.152mm, calculate modulus of elasticity of brass.

13.A punch with a diameter 20mm is used to punch a hole in an aluminium plate of thickness 4mm .If the ultimate shear stress for the aluminium is 275MPa, what force P is required to punch through the plate.

14.The following data pertains to a tension test conducted in laboratory:

i. Diameter of the specimen = 15mm
ii. Length of the specimen = 200mm
iii. Extension under a load of 10 KN=0.035mm
iv. Load at yield point = 110KN
v. Maximum load = 190 KN
vi. Length of the specimen after failure = 255mm
vii. Neck diameter = 12.25mm

Determine: i) Young's modulus, ii) Yield stress iii) Ultimate stress, iv) Percentage elongation, v) percentage reduction in area, vi) safe stress adopting factor of safety of 1.5.

15.A rod of diameter 15mm and 50mm long is subjected to tensile load of 25KN. The modulus of elasticity for steel rod may be taken as 200 KN/mm^2. Find stress, strain and elongation of the bar due to applied load.

16.A rod of cross sectional area 15mm x 15mm and 1m long is subjected to a compressive load of 22.5KN. calculate the stress and decrease in length if young's modulus is 200GN/m^2.

17.A load of 4KN is to be raised with the help of a steel wire. The permissible tensile stress should not exceed 70N/mm^2. What is the minimum diameter of wire required? What will be extension for 3.5m length of wire? Assume young's modulus is 196.2 GN/m^2.

18.A mild steel bar of 15mm diameter was subjected to tensile test. The test bar was found to yield at a load of 90KN and it attains maximum load of 180KN and ultimately fails at a load of 67.5 KN. Determine the following: tensile stress at the yield point, ultimate stress and stress at the breaking point, if the diameter of the neck is 7.5mm.

19.The following data pertains to a tension test conducted in laboratory:

i. Diameter of the specimen = 20mm
ii. Gauge Length of the specimen = 100mm
iii. Final length=130mm
iv. Final diameter =11.5mm
v. Yield Load = 92KN
vi. Ultimate load = 165 KN

Determine: i) Yield stress ii) Ultimate tensile stress, iii) Percentage elongation, iv) percentage reduction in area.

20.A hallow steel column has to carry an axial load of 3MN. If the external diameter of the column is 300mm, find the internal diameter. The ultimate stress for steel is to be 480N/mm^2. Take factor of safety as 4.

21.A short column has an internal diameter of 200mm. What should be the minimum external diameter so that it may carry a load 1600KN with factor of safety 7.5. Take ultimate stress of steel as 472N/mm^2.

22.A steel rod 30mm x 12.5mm and 500mm long is subjected to a axial pull of 75KN. Determine the changes in length, width and thickness and volume of bar. If young's modulus is 200KN/mm^2.

23.A steel bar 2.4 long and 30mm square is elongated by a load 400KN. If poisons ratio is 0.25 find the increase in volume. Assume E=200KN/mm^2.

24.The young's modulus for a given material is 100KN/mm^{2}and its modulus of rigidity is 40KN/mm^2. Determine its bulk modulus and also its lateral contraction if the diameter is 50mm and length 2m and extension 2mm.

25.A bar of steel 1m long 50mm wide and 10mm thickness is subjected to an axial load of 10KN in the direction of its length. Find the changes in length, width, thickness and volume.

26.A bar of 30mm diameter is subjected to an axial pull of 80KN. The measured extension is 0.1 mm on a gauge length of 200mm and the change in diameter is 0.004mm. calculate the poisson's ratio and the values of young's Modulus, bulk modulus and Modulus of rigidity.

CO 2: Interpret the Variation of moment of inertia for different Mechanical Engineering Sections such as fly wheel

LEVEL: REMEMBER

1. Define centre of Gravity and Moment of Inertia
2. State Parallel and perpendicular axis theorem

LEVEL: UNDERSTANDING

3. Locate CG for Triangle Rectangle, Circle, Semi-circle, Trapezium, Cone with the help of plain figure

LEVEL: APPLICATION

4. Determine the centroid of the T-section of a flange 100 X 10 mm. Also find the M.I. of the section about XX axis through centroid.
5. Find the centre of gravity of the I-section having top flange of 100 X 20 mm, web 120 X 20 mm and bottom flange 150 X 20 mm. Also find M.I. of the section about XX axis passing through C.G. of the section.
6. Find the C.G. of L-section of dimensions 100 X 80 X 20 mm. Also find the M.I. of the section through C.G. and parallel to shorter leg.
7. Find the moment of Inertia about the centroidal axis XX and YY of the T-section 160 mm wide and 160 mm deep. The flange and web thickness 50 mm each.
8. Find the M.I. about the centroidal XX axis parallel to the flange for the T-beam. Size of the flange120 X 20 mm, size of web 120 X 20 mm.
9. An I section consists of top flange 100 X 30 mm, bottom flange 200 X 40 mm and web 180 X 20 mm. Find the M.I. about an axis passing through C.G. parallel and perpendicular to the base.
10. Calculate M.I. of an angle section 100 X 80 X 10 mm about an axis passing through the centroid and parallel to shorter leg.
11. Calculate the C.G. and moment of inertia for a Channel section of size 100 X 100 X 20 mm about XX and YY axis.

C0 03: Draw and Compare the shear force and bending moment diagram on beams under varying load conditions.

LEVEL: REMEMBER

1. Define Shear force and Bending Moment in beams
2. Name the types of loads acting on beams with illustration

LEVEL: UNDERSTANDING

3. Explain Sagging and Hogging bending Moment
4. Explain Point of Contra flexure in a beam

LEVEL: APPLICATION

5. A cantilever beam of length 3m subjected to a point load of 5 KN, 8KN and 12 KN at a distance of 1m, 1.5m and 2.5m from the free end. Draw SFD and BMD.
6. A cantilever beam of length 4m subjected to a point load of 3 KN, 5KN and 8 KN and 10 KN at a distance of 1m, 1.5m and 3m and 3.5 m from the free end. Draw SFD and BMD.
7. A cantilever beam of length 3 m subjected to two point loads of 10 KN acting at the free end and 15KN at the middle of the beam. Draw SFD and BMD.
8. A cantilever beam 1.5 m long carries point loads of 1 KN, 2KN and 3 KN at 0.5 m, 1.0 m and 1.5 m from the fixed end respectively. Draw the SFD and BMD for the beam.
9. A cantilever beam of 1.4 m length carries a uniformly distributed load of 1.5 KN/m over its entire length. Draw S.F and B.M diagrams for the cantilever.

10. A cantilever AB 1.8 m long carries a point load of 2.5 KN at its free end and a uniformly distributed load of 1 KN/m from A to B. Draw the shear force and the bending moment diagrams for the beam.
11. A cantilever beam of 2 m length carries a uniformly distributed load of 1.5 KN/m over its entire length and also a point load of 3 KN at a distance of 0.5 m from the free end. Draw S.F and B.M diagrams for the cantilever.
12. A cantilever of length 2.5 m carries a uniformly distributed load of 2 KN/m for a length of 2 m from the free end and a point load of 2 KN at the free end. Draw the shear force and the bending moment diagrams for the beam.
13. A cantilever of length 3 m carries a uniformly distributed load of 1.5 KN/m for entire length and a point load of 2 KN at a distance of 1 m from the free end. Draw the shear force and the bending moment diagrams for the beam.
14. A cantilever 5 m long carries point loads of 30 KN and 10 KN at a distance of 1 m from the fixed end. In addition to this the beam carries a UDL of 10 KN/m between point loads. Draw shear force and bending moment diagrams for the cantilever.
15. A simply supported beam of length 6 m carries point loads of 2.5 KN and 4 KN at a distance of 2 m and 4 m from left support. Draw S.F. and B.M. diagrams for the beam.
16. A simply supported beam of length 5 m carries point loads of 2 KN and 4 KN and 5 KN at a distance of 1 m, 3 m and 4 m from left support. Draw S.F. and B.M. diagrams for the beam.
17. A simply supported beam of length 8m carries a UDL of 10KN/m for a distance of 6m from left support. Draw S.F and B.M diagram for the above beam. Also calculate the maximum B.M. on section.
18. A simply supported beam of length 8m carries two point loads of 30KN and 40KN respectively at a distance of 1.5m and 6.5m from the left support. Also it carries a UDL of 10KN/m between the point loads, draw shear force and bending moment diagram.
19. A simply supported beam of 6m span is carrying a UDL of 20KN/m over a length of 3m from right support. Draw S.F d and BMD. Also calculate maximum B.M.
20. Draw S.F and B.M diagram for a simply supported beam 6m long carrying UDL of 2KN/m over the entire length and point loads of 5 KN,4 KN and 3 KN at 3m,4m and 5m from left support respectively.
21. A simply supported beam of span 6m carries two point loads of 5 KN and 10 KN at 1m and 2m respectively from left support and also carries an UDL of 10KN/m over a length of 3m from the right support. Draw SFD and BMD.

CO 04: Assess Bending and shear stresses in beams subjected to different loadings for different machine parts

LEVEL: REMEMBER

1. List the aassumptions in theory of simple bending
2. Describe the relation between Bending Stress and Radius of Curvature
3. Describe the moment of resistance and radius of Curvature in a beam

LEVEL: UNDERSTANDING

4. Explain Beams of Uniform Strength
5. Explain modulus of Section for Rectangular and Circular sections

LEVEL: APPLICATION

1. Write Bending equations with all notation
2. A steel wire of 10mm diameter is bent into circular shape of 5m radius, determine the maximum stress induced in the wire. Take $E=2X10^5$ N/mm^2.
3. A steel plate is bent into a circular arc of radius 10m.The plate is 100mm wide and 15mm thick, assuming the value of $E=2X10^5$ N/mm^2.Find the maximum stress induced in the plate and value of bending moment which produced this stress.
4. The moment of inertia of a beam section 500mm deep is $700X10^6$ mm^4.Find the longest span over which a beam of this section when simply supported could carry a UDL of 40 KN/m. The maximum flange stress in the material is not to exceed 110 N/mm^2.
5. A cast iron pipe of external diameter 65mm and internal diameter of 45mm and of length 5m is supported at its ends. Calculate the maximum bending stress induced in the pipe if it carries a point load of 100N at its centre.
6. A rectangular beam 300mm deep is simply supported over a span of 4m. What UDL/m the beam can carry if bending stress is not to exceed 120 N/mm^2. Take $I=80X10^6$mm^4.
7. A timber joist 150 X 250 mm is simply supported over a span of 3m. If it carries a total UDL of 10 KN/m inclusive of its weight, find the maximum stress induced in the joist.
8. A rectangular beam 300 mm deep is simply supported over a span of 4 m. What UDL the beam may carry if the bending stress is not to exceed 120 MPa. Take $I=225 X 10^6$ mm^4.
9. A simply supported wooden beam of span 1.3 m is carrying a central point load of 40 KN. If the allowable bending stress in the timber is taken as 8 N/mm^2, find the breadth and depth of the timber. Take b=0.6d.
10. A circular pipe of external diameter 70 mm and thickness 10 mm is used as a simply supported beam over an effective span of 2.5 m. Find the maximum point load that can be applied at the centre of span if permissible stress in the tube is 150 N/mm^2.
11. .A steel plate is bent into an arc of a circle of radius 10 m. If the breadth of the plate is 150 mm and thickness 25 mm and $E=2X10^5$ N/mm^2, calculate the maximum stress induced in the plate and the bending moment which can produce this stress.
12. A timber is freely supported and has a span of 6 m. If the UDL of 10 KN/m and a point load of 5 KN at a point 3.5 m from left support is loaded. Determine the dimensions of the beam. Assume depth of beam as twice as its breadth. Take f=10 N/mm^2
13. A beam is simply supported and carries UDL of 30 KN/m over the entire span. The section of the beam is rectangular having depth of 400mm. If maximum stress in the material is 120 N/mm^2 and M.I. of the section is $7 X 10^8$, find the span of the beam.
14.

CO 05: Differentiate in strain energy stored in a body when the load is suddenly applied and gradually applied

LEVEL: UNDERSTANDING

1. Explain Strain energy and Resilience
2. Explain proof resilience and modulus of resilience
3. Explain Suddenly applied and gradually applied load
4. Explain Suddenly applied and Impact load

LEVEL: APPLICATION

5. Calculate the strain energy stored in a bar 2.5 m long ,50mm wide and 40mm thick when it is subjected to a tensile load of 50KN.Take young's modulus is $2x10^5$ N/mm^2
6. An axial pull of 25KN is suddenly applied on a steel rod of 3 m long and 900mm^2 in cross-sectional area. Calculate the strain energy stored in the rod. Take young's modulus is $2x10^5$ N/mm^2.

CO 06: Design simple solid and hallow shaft for power transmission keeping view of Environmental and sustainability aspects**.**

LEVEL: REMEMBER

1. List the assumptions made in theory of Torsion

LEVEL: APPLICATION

2. Write the torsion equation with all notations
3. Compare the Strength of Hollow and Solid shaft
4. A solid circular shaft is required to transmit 100KW at 200 rpm. The permissible shear stress in the shaft is 70 N/mm^2.Find the diameter of the shaft.
5. A solid circular shaft is required to transmit 90KW at 180 rpm. The permissible shear stress in the shaft is 75 N/mm^2.The maximum Torque transmitted exceeds the mean torque by 20% more than mean torque. Find the suitable diameter of the shaft.
6. .A solid circular shaft is required to transmit 120KW at 180 rpm. The permissible shear stress in the shaft is 70 N/mm^2.The maximum Torque transmitted exceeds the mean torque by 30% more than mean torque. Find the suitable diameter of the shaft. Also find the angle of twist in a length of 2 meter. The valve of rigidity modulus is 0. $9x10^5$ N/mm^2.
7. A solid circular shaft is required to transmit 100KW at 180 rpm. The permissible shear stress in the shaft is 60 N/mm^2. Find the suitable diameter of the shaft. The angle of twist is not to exceed 1^0 in a length of 3 meter. The valve of rigidity modulus is 0. $8x10^5$ N/mm^2.
8. A solid shaft of diameter is 110 mm required to transmit 180KW at 120 rpm. The angle of twist is not to exceed 1.5^0 .Find the length of shaft. The valve of rigidity modulus is 0. $8x10^5$ N/mm^2.
9. A solid circular shaft is required to transmit 40KW at 120 rpm. The permissible shear stress in the shaft is 40 N/mm^2.The maximum Torque transmitted exceeds

the mean torque by 25% more than mean torque. Find the suitable diameter of the shaft.

10. A solid circular shaft is required to transmit 80KW at 160 rpm. The permissible shear stress in the shaft is 60 N/mm^2.The maximum Torque transmitted exceeds the mean torque by 20% more than mean torque. The angle of twist is not to exceed 1^0 in a length of 20 times the diameter of the shaft. The valve of rigidity modulus is $0.8x10^5$ N/mm^2.Find the diameter of the shaft.
11. 8. A solid circular shaft is required to transmit 75KW at 200 rpm. The permissible shear stress in the shaft is 50 N/mm^2.The maximum Torque transmitted exceeds the mean torque by 20% more than mean torque. The angle of twist is not to exceed 1.2^0 in a length of 30 times the diameter of the shaft. The valve of rigidity modulus is $84x10^3N/mm^2$.Find the diameter of the shaft.
12. A solid circular shaft is required to transmit 1MW at 240 rpm. The permissible shear stress in the shaft is 60 N/mm^2.The maximum Torque transmitted exceeds the mean torque by 25% more than mean torque. The angle of twist is not to exceed 1^0 in a length of 2.5 meter. The valve of rigidity modulus is $80KN/mm^2$.Find the diameter of the shaft.
13. A Hollow shaft is required to transmit 300KW at 90 rpm. The permissible shear stress in the shaft is 60 N/mm^2.The maximum Torque transmitted exceeds the mean torque by 25% more than mean torque. The internal diameter is half of the external diameter, Find the internal diameter and external, diameters of the shaft.
14. A Hollow shaft is required to transmit 500KW at 100 rpm. The permissible shear stress in the shaft is 60 N/mm^2.The maximum Torque transmitted exceeds the mean torque by 15% more than mean torque. The internal to external diameter ratio is 3/5. The angle of twist is not to exceed 1^0 in a length of 3.5 meter The valve of rigidity modulus is $80KN/mm^2$.Find the minimum external diameter of the shaft.
15. A solid circular shaft is required to transmit 40KW at 400 rpm. The Ultimate shear stress in the shaft is 360 N/mm^2 with a factor of safety as 8.The maximum Torque transmitted exceeds the mean torque by 15% more than mean torque. Find the diameter of the shaft.
16. If a Hollow shaft is to be used in place of solid shaft, Find the internal diameter and external, diameters of the shaft with the internal to external diameter ratio is 1/2.The material is same