Q.6 i. What are the assumptions made in Euler's Analysis? **4**

ii. Compare the Crippling loads given by Rankine's and Euler's formulae for tabular strut 225 cm long having Outer and inner diameter of 37.5 mm and 32.5 mm respectively loaded through pin joints at both ends. **6**

Take yield stress as 315MPa;
a=1/7500 and E= 200GPa.

OR iii. Define: **6**

(a) Unsymmetrical bending (b) Shear Centre

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Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2019

CE3ES10 Strength of Material

Programme: B.Tech. Branch/Specialisation: CE

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated.Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. What are the limiting values of Poisson's ratio? **1**

(a) -1 and 0.5 (b) -1 and -0.5 (c) 1 and -0.5 (d) 0 and 0.5

ii. A composite bar has four sections each of length 100mm, 150mm, 200mm, 250mm. When force is applied, all the sections causes an elongation of 0.1mm. What will the resultant strain in the bar? **1**

(a) 0.0012 (b) 0.00154 (c) 0.00256 (d) 0.0020

iii. The ratio of maximum deflection of a beam to its _____ is called stiffness of the beam. **1**

(a) Load (b) Slope

(c) Span (d) Reaction at the support

iv. In cantilever beams, the deflection is zero at _____ **1**

(a) Free end (b) Fixed end

(c) At supports (d) Through out

v. If a beam is subjected to pure bending, then the deformation of the beam is_____ **1**

(a) Arc of circle (b) Triangular

(c) Trapezoidal (d) Rectangular

vi. Maximum Shearing stress in a beam is at _____ **1**

(a) Neutral axis (b) Extreme fibres

(c) Mid span (d) Action of loading

vii. Torsional sectional modulus is also known as _____ **1**

(a) Polar modulus (b) Sectional modulus

(c) Torsion modulus (d) Torsional rigidity

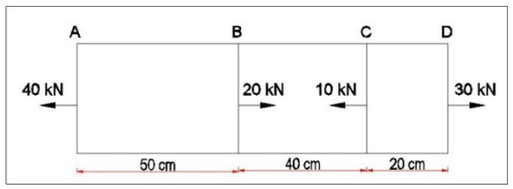
P.T.O.

viii. Twisting moment is a product of _____ and the radius. **1**
(a) Direction (b) Velocity (c) Force (d) Acceleration

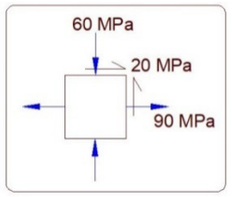
ix. Eccentrically loaded columns have to be designed for combined axial and _____ **1**
(a) Shear force (b) Bending moments
(c) Torsion (d) Creep

x. Bond stress is a stress acting _____ to the bar on the interface between reinforcement and concrete. **1**
(a) Perpendicular (b) Parallel
(c) Normal (d) Transverse

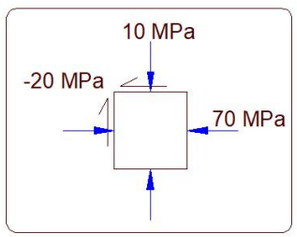
Q.2 i. A Steel Bar 25 mm dia is loaded as shown in figure. Determine the stresses in each part and total elongation. E= 210 GPa. **4**



ii. Find the Principal Stresses $\sigma_1, \sigma_2, \tau_{max}$ in-plane. Also Calculate θ_{p1}, θ_{s1}. **6**



OR iii. Use the Mohr's Circle to determine Principal Planes $\sigma_1, \sigma_2, \tau_{max}$ in-plane. Also Calculate θ_{p1}, θ_{s1}. Also find the stresses $\sigma_x, \sigma_y, \tau_{xy}$ for θ=60° (CW) from the principal plane. **6**



Q.3 i. Define: **4**
(a) Principle of Superposition
(b) Double Integration Method

ii. 3 metre long cantilever of uniform rectangular cross section, 15 cm wide and 30 cm deep is loaded with 30 kN load at its free end. In addition to this, it carries a UDL of 20 kN per metre Run over its entire length. Calculate: **6**
(a) Maximum slope and maximum deflection
(b) The slope and deflection at 2 metres from the fixed end.
Take E= 210 GN/m^2

OR iii. A simply supported beam of span l carries a point load W (not at mid span). Using the Conjugate Beam Method, determine the slopes at the ends of the beam and the deflection under the load. **6**

Q.4 i. What are the assumptions in the theory of bending? **4**

ii. Derive equation of bending. **6**

OR iii. Define: **6**
(a) Section modulus (b) Neutral axis
(c) Moment of resistance

Q.5 i. What are the assumptions that are to be considered while deriving Torsion Equation? **4**

ii. Derive Torsion equation. Also determine the power transmitted by a solid shaft of 5cm diameter while rotating at 120 rpm. Maximum permissible shear stress is 8 kN/cm^2. **6**

OR iii. A steel shaft of 10 cm diameter is subjected to pure twisting moment and is 20 metre long. It is driven at one end while the power is taken off at the other end. one end of the shaft moves 30 degree in advance of the other end. Find **6**
(a) The maximum shear stress in the shaft
(b) The torque
(c) The power transmitted at 120 RPM. Take C= 8 MN/cm^2.

P.T.O.

Marking Scheme
CE3ES10 Strength of Material

Q.1	i.	What are the limiting values of Poisson's ratio? (d) 0 and 0.5	**1**
	ii.	A composite bar has four sections each of length 100mm, 150mm, 200mm, 250mm. When force is applied, all the sections causes an elongation of 0.1mm. What will the resultant strain in the bar? (c) 0.00256	**1**
	iii.	The ratio of maximum deflection of a beam to its _____ is called stiffness of the beam. (c) Span	**1**
	iv.	In cantilever beams, the deflection is zero at _____ (b) Fixed end	**1**
	v.	If a beam is subjected to pure bending, then the deformation of the beam is_____ (a) Arc of circle	**1**
	vi.	Maximum Shearing stress in a beam is at _____ (a) Neutral axis	**1**
	vii.	Torsional sectional modulus is also known as _____ (a) Polar modulus	**1**
	viii.	Twisting moment is a product of _____ and the radius. (c) Force	**1**
	ix.	Eccentrically loaded columns have to be designed for combined axial and _____ (b) Bending moments	**1**
	x.	Bond stress is a stress acting _____ to the bar on the interface between reinforcement and concrete. (b) Parallel	**1**

Q.2	i.	Determine the stresses in each part and total elongation.		**4**
		σ_{AB}	1 mark	
		σ_{BC}	1 mark	
		σ_{CD}	1 mark	
		Change in length	1 mark	
	ii.	Principal Stresses $\sigma_1, \sigma_2, \tau_{max}$ in-plane. Also Calculate θ_{p1}, θ_{s1}.		**6**
		Diagram	1 mark	
		σ_1	1 mark	
		σ_2	1 mark	
		τ_{max}	1 mark	
		θ_{p1},	1 mark	
		θ_{s1}	1 mark	
OR	iii.	Mohr's Circle	1 mark	**6**
		$\sigma_1, \sigma_2, \tau_{max}$ in-plane	1 mark	
		θ_{p1}, θ_{s1}.	1 mark	
		Stresses $\sigma_x, \sigma_y, \tau_{xy}$ for θ=60° (CW)	3 marks	

Q.3	i.	Define:		**4**
		(a) Principle of Superposition	2 marks	
		(b) Double Integration Method	2 marks	
	ii.	Diagram	2 marks	**6**
		(a) Maximum slope and maximum deflection	2 marks	
		(b) The slope and deflection at 2 metres	2 marks	
OR	iii.	Diagram	1 mark	**6**
		Conjugate Beam with M/EI loads	1 mark	
		BM of Conjugate Beam	2 marks	
		SF of Conjugate Beam	2 marks	

Q.4	i.	Assumptions in the theory of bending		**4**
	ii.	Derivation of bending. Stepwise marking		**6**
OR	iii.	Define:		**6**
		(a) Section modulus	2 marks	
		(b) Neutral axis	2 marks	
		(c) Moment of resistance	2 marks	

Q.5	i.	Assumptions while deriving Torsion Equation		**4**
	ii.	Derive Torsion equation	2 marks	**6**
		Solution	4 marks	

OR	iii.	(a) The maximum shear stress in the shaft	2 marks	**6**
		(b) The torque	2 marks	
		(c) The power transmitted	2 marks	
Q.6	i.	Assumptions made in Euler's Analysis?		**4**
	ii.	Crippling loads given by Rankine's		**6**
		Definition	1 mark	
		Calculation for numerical	2 marks	
		Euler's formulae		
		Definition	1 mark	
		Calculation for numerical	2 marks	
OR	iii.	Define:		**6**
		(a) Unsymmetrical bending	3 marks	
		(b) Shear Centre	3 marks	

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