Scheme of Valuation/Answer Key

(Scheme of evaluation (marks in brackets) and answers of problems/key)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: ME201

Course Name: MECHANICS OF SOLIDS (ME,MP,MA,MT,AU,PE,SF)

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer any three full questions, each carries 10marks		Marks
1	a)	Derivation with figure		(5)
	b)	. A1 = 706.86 mm^2 , A2 = 628.32 mm^2 …………… **$\Delta = \Delta 1 + \Delta 2 = \frac{P}{E}\left(\frac{L}{A} + \frac{L}{A}\right)$ ……………** Substituting and solving E = 3.31 x 10^5 N/mm^2 ………..	1M 2M 2 M	(5)
2		$\Delta_S + \Delta_b = \alpha_b tL - \alpha_s tL$ ……………………………………. Solving P= 20911.2 N ………………………………. Stress in steel =P/As = 14.2 N/mm2 …………………………………. Stress in brass= P/Ab = 42.6 N/mm2…………………………………. OR As =π(502-252)/4: Ab = π(252)/4 ……………………………. σS/ES + σb/Eb = αb.t – αs.t ………………………….. σS x As = σb x Ab from this equation σS = 3 σb…………… Stress in steel , σ_S = 14.2 N/mm2 …………………………………. Stress in brass, σ_b = 42.6 N/mm2…………………………………	2 M 4 M 2 M .2 M 2 M 2 M 2 M 2 M 2 M	(10)
3	a)	Poissons ratio =Lateral strain/ Longitudinal strain = 0.25 ……………… E=2G(1+μ)…………… G=8.4 x 10^4 N/mm^2 ……….. E=3K((1-2μ)…………… K=1.4 x 10^5 N/mm^2 ……….	1M 1M 1M 1M .1M	(5)
	b)	True stress-strain curve with all salient points		(5)
4		Js = $\frac{\pi}{3}$ 40^4 = 251327.41 mm^4		10

		$Ja = \frac{\pi}{3}(50^4 - 40^4) = 362264.9\ mm^4$ .... 2M $\frac{T}{G_s J_i} = \frac{T}{G_a J_i}$ Ts = 2.05 Ta.. 2 M If stress in steel governs the resisting capacity $\frac{T}{J_i} = \frac{q_s}{R}$.. 1M Ts=1507964.46 N.mm Ta=735592.42 Nmm T= Ts+ Ta =2243556.86 N.mm = 2243.56 Nm ....2M If stress in aluminium governs the resisting capacity $\frac{T}{J_i} = \frac{q_a}{R}$ Ta =724529.8 N.mm Ts = 1485286.09 N.mm T= Ts+ Ta =2209815.89 N.mm = 2209.82 Nm ....2M Stress in Steel governs the torque carrying capacity T=2243.56 Nm .... 1 M	
PART B			
Answer any three full questions, each carries 10marks			
5		Figure..........................1M Reactions at supports R_A = 65 kN, R_B = 15 KN..................... 2 M Shear force diagram......................... 3 M Bending Moment diagram............. 4 M	(10)
6	a)	Relation between load, shear force and bending moment	(5)
	b)	Reactions at supports R_A = - 4 kN, R_B = 4 KN..................... 1 M Shear force diagram........................ 2 M Bending Moment diagram............. 2 M	(5)
7		Moment of Inertia of I section = $28490.72 \times 10^4\ N/mm^2$ .... 2M Distance of top layer from NA = 133.49 mm, Distance of bottom layer from NA = 166.51 mm .... 2M M= WL/4 = 20 kN-m = 20×10^6 N.mm .... 1 M $\frac{\sigma}{y} = \frac{M}{I}$ 1M	

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		Max tensile Stress, σ_t = 11.68 N/mm^2 .... 2M Maxcompressive Stress, σ_c = 9.37 N/mm^2 .... 2M	
8		I= 52160000 mm^4 .... 2M Shear stress distribution in top and bottom flange .... 3 M Shear stress distribution in web .... 3 M Shear stress distribution diagram.................................. 2M	(10)
PART C			
Answer any four full questions, each carries 10marks.			
9		Reactions at supports R_A = 50 kN, R_B = 50 KN..................... 1 M Using Macaulays method, Mx = R_A.x -10(x-2)^2 + 10(x-7)^2..................... 1 M Solving Constants of Integration, C_1= - 454.166, C_2 = 0 .... 3 M Slope equation and Defection equation....................... 2 M Deflection at mid span = 13.16 mm .... 2 M Maximum deflection = 13.16mm........................ 1 M	(10)
10		Reactions at supports R_A = 3.333 kN, R_B = 6.667 KN..................... 1 M BM diagram.....................2M Conjugate Beam.....................2M Reactions at supports of conjugate beam R^*_A = 17.77/EI kN, R^*_B = 22.22/EI kN.....................1M Slope at left support = 4.44 x 10^{-4} rad .... 2M Deflection under load = 8.88 x 10^{-4} m 2M	(10)
11		Maximum principal stress =$\left(\frac{p\ +p}{2}\right)+\sqrt{\left(\frac{p\ -p}{2}\right)^2+q^2}$......................... 2M Shear stress, q=72.11 N/mm^2 ----------------------------------2M Minimum Principal Stress ==$\left(\frac{p\ +p}{2}\right)-\sqrt{\left(\frac{p\ -p}{2}\right)^2+q^2}$..= - 129.9 N/mm2.....3M	(10)

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		Maximum Shear stress = $\sqrt{(\frac{P\ -P}{2})^2 + q^2}$ = 139.9 N/mm^2,.............. 3M **Note: Solutions obtained by using Mohr's circle should also be considered.**	
12		Derivation for Eulers crippling load	(10)
13		I = $\frac{b\ ^3}{1}$ =66.67 x 10^6 mm^4 ,.............. 1M At 20 mm below top fibre, σ = $\frac{M}{I}$ y = 23.99 N/mm2,.............. 2M Shear stress, q =$\frac{F\ \bar{y}}{I_l}$ y =1.08 N/mm^2,.............. 3M Px=23.99 N/mm2, Py= 0, q =.1.08 N/mm^2 Maximum principal stress = =$(\frac{P\ +P}{2}) + \sqrt{(\frac{P\ -P}{2})^2 + q^2}$ = 24.04. N/mm^2......2M Minimum Principal Stress ==$(\frac{P\ +P}{2}) - \sqrt{(\frac{P\ -P}{2})^2 + q^2}$..= - 0.05 N/mm^2.....2M	(10)
14		Rankine's load P = σ_c A/[1+a(l_e /k)^2]..................................... 2M Radius of gyration k = 62.5 mm .... 2M P= 1118.26 kN.. 2M Eulers formula P= π^2EI/l^2 .... 2M P = 1619.12 kN... 2M	(10)
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Note: Evaluation is not strictly based on final answer and credit should be given to steps followed.

Chairman