Marking scheme & Solution

U218-154(T1)

OCTOBER 2018/ IN-SEM (T1)

S. Y. B. TECH. (MECHANICAL ENGINEERING) (SEMESTER - I)

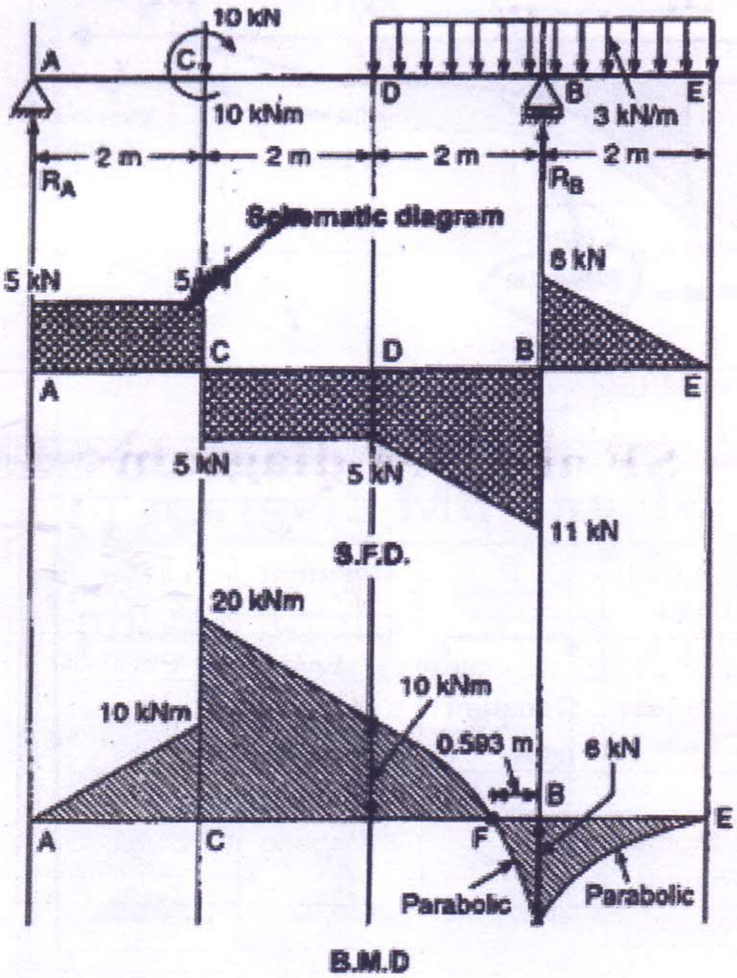
COURSE NAME: **Strength of Materials**

COURSE CODE: **MEUA21174**

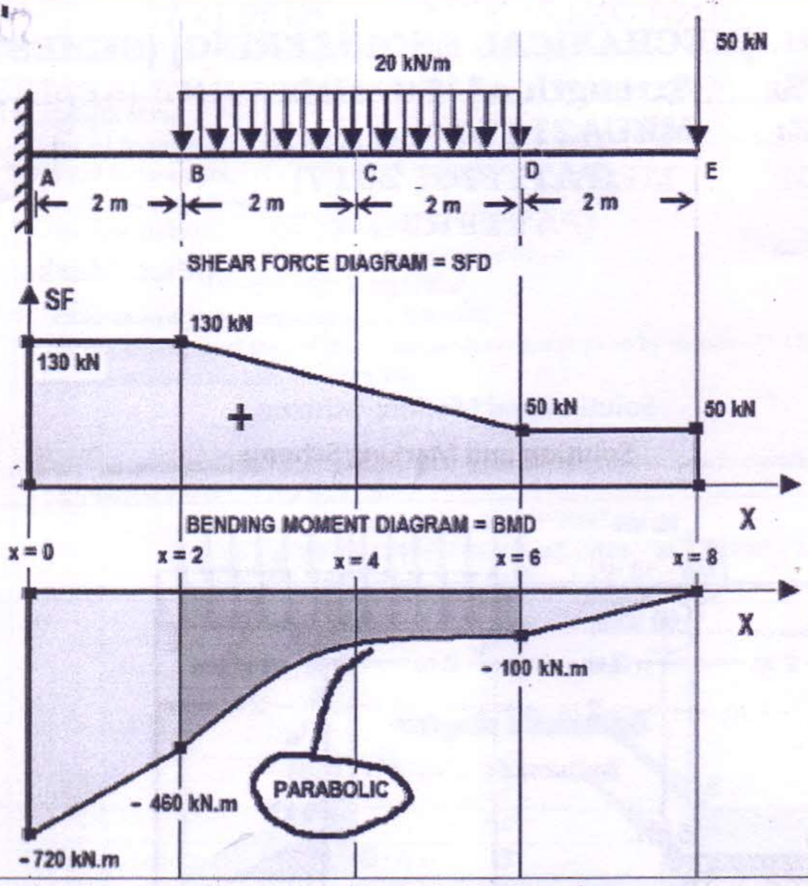
(PATTERN 2017)

Time: [**1Hour**] [Max. Marks: **30**]

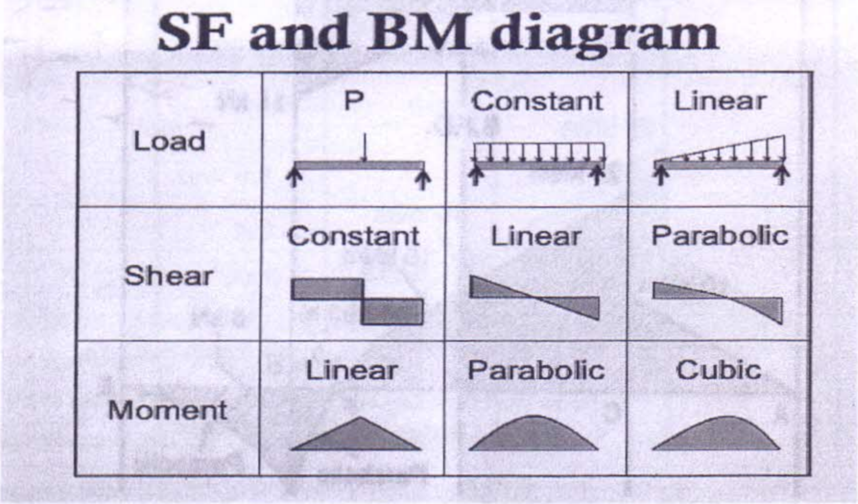
Solution and Marking Scheme

Q1	a		06

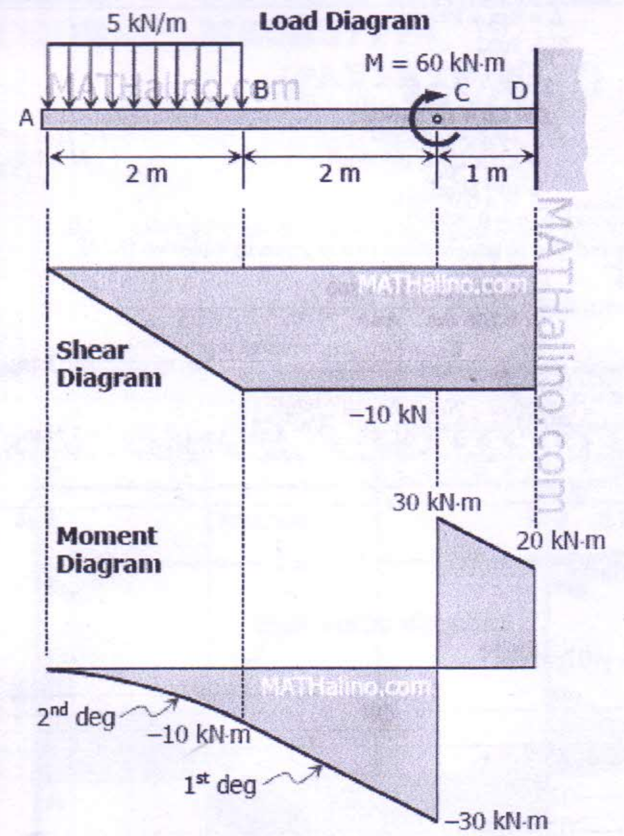
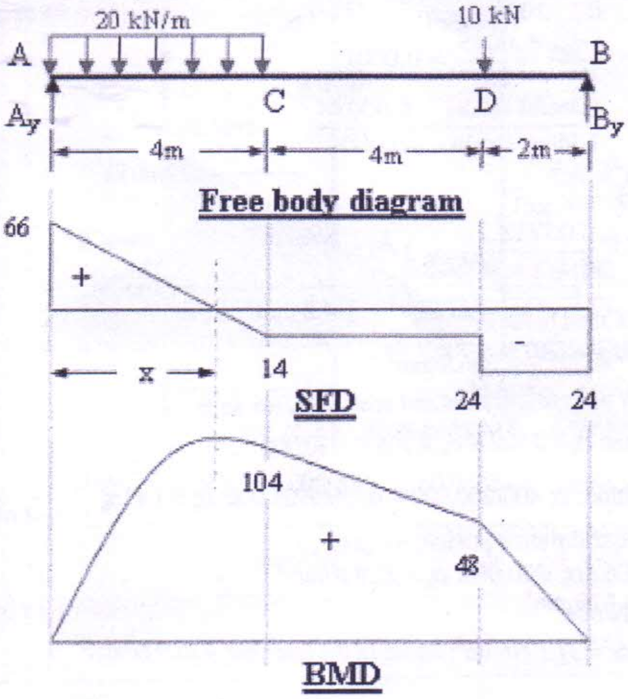
	b		06



	c	Application- 2 marks, Load and its variation 2 marks	04



OR

Q2	(a)		
	b		06
	c	Explanation 2 marks SFD & BMD 2 Marks	04
Q3	a	Stress-Strain curve with all points-------03 marks Explanation of all points------------------03 marks	06

	b	Length of rod, $L = 2\text{ m} = 200\text{ cm}$ Initial temperature, $T_1 = 10°C$ Final temperature, $T_2 = 80°C$ $\therefore$ Rise in temperature, $T = T_2 - T_1 = 80° - 10° = 70°C$ Young's Modulus, $E = 1.0 \times 10^5\text{ MN/m}^2$ $= 1.0 \times 10^5 \times 10^6\text{ N/m}^2$ $(\because M = 10^6)$ $= 10^{11}\text{ N/m}^2$ Co-efficient of linear expansion, $\alpha = 0.000012$ (i) The expansion of the rod due to temperature rise is given by equation (1.13). $\therefore$ Expansion of the rod $= \alpha.T.L$ $= 0.000012 \times 70 \times 200$ $= 0.168$ cm. **Ans.** (ii) The stress in the material of the rod if expansion is prevented is given by equation (1.15). $\therefore$ Thermal stress, $\sigma = \alpha . T . E$ $= 0.000012 \times 70 \times 1.0 \times 10^{11}\text{ N/m}^2$ $= 84 \times 10^6\text{ N/m}^2 = 84\text{ N/mm}^2$. **Ans.** $(\because 10^6\text{ N/m}^2 = 1\text{ N/mm}^2)$	
	c	$\frac{\sigma_1}{\sigma_2} = 1$ --------------02marks $\frac{\delta l_1}{\delta l_2} = 0.4347$ ------------02marks	04
		OR	
Q4	a	i) Youngs modulus-----------02 marks ii) Factor of safety ----------02 marks iii) Thermal stress ---------- 02 marks	06
	b	Linear strain $= \frac{\Delta}{L} = \frac{0.12}{200} = 0.0006$ Lateral strain $= \frac{\Delta d}{d} = \frac{0.0045}{25} = 0.00018$ Poisson's ratio $= \frac{\text{Lateral strain}}{\text{Linear strain}} = \frac{0.00018}{0.0006}$ $\mu = 0.3$ -----------02 marks $E = 3K(1 - 2\mu)$, we get $K = \frac{E}{3(1-2\mu)} = \frac{203718.3}{3(1-2\times 0.3)} = 169\text{ N/mm}^2$ ---------02 marks	04
	c	***Solution*** Area of steel bar $= \pi(20)^2/4 = 314.2\text{ mm}^2$ Area of brass bar $= \pi(30)^2/4 = 706.8\text{ mm}^2$ From the free body diagrams of steel and brass bars, we write Equilibrium condition: $\sigma_s \times 314.2 + \sigma_b \times 706.8 = 30{,}000$ Compatibility condition: $\sigma_s\, 400/200{,}000 = \sigma_b\, 300/105{,}000$; $\sigma_s = 1.43\sigma_b$ ------2 marks Substituting in the equilibrium equation, we get $1.43\sigma_b \times 314.2 + 706.8\sigma_b = 30{,}000$; $\sigma_b = 25.9\text{ N/mm}^2$ $\sigma_s = 1.43\sigma_b = 37.1\text{ N/mm}^2$ Stress in the steel bar $= 37.1\text{ N/mm}^2$; Stress in the brass bar $= 25.9\text{ N/mm}^2$ -------2 marks	04