

ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ ΚΑΙ ΠΟΛΙΤΙΣΜΟΥ
ΔΙΕΥΘΥΝΣΗ ΑΝΩΤΕΡΗΣ ΚΑΙ ΑΝΩΤΑΤΗΣ ΕΚΠΑΙΔΕΥΣΗΣ
ΥΠΗΡΕΣΙΑ ΕΞΕΤΑΣΕΩΝ

ΠΑΓΚΥΠΡΙΕΣ ΕΞΕΤΑΣΕΙΣ 2011

ΛΥΣΕΙΣ

ΤΕΧΝΟΛΟΓΙΑ (Ι) ΘΕΩΡΗΤΙΚΗΣ ΚΑΤΕΥΘΥΝΣΗΣ

Μάθημα: Εφαρμοσμένη Μηχανική Επιστήμη

Ημερομηνία και ώρα εξέτασης: Τρίτη, 24 Μαΐου 2011
11:00 – 13:30

ΜΕΡΟΣ Α: Δώδεκα (12) ερωτήσεις.
Κάθε ορθή απάντηση βαθμολογείται με τέσσερις (4) μονάδες.

1. (β)

2. (γ)

3. (β)

4. (γ)

5. (β)

6. (δ)

7.

$$I_{xx} = \frac{60 \cdot 80^3}{12} - \frac{40 \cdot 60^3}{12} = 1,84 \cdot 10^6 \text{ mm}^4$$

8.

$$\frac{M_{b \max}}{I} = \frac{\sigma_{\max}}{y} = \frac{E}{R} \Rightarrow \sigma_{\max} = \frac{M_{b \max} \cdot y}{I}$$

$$I = \frac{bh^3}{12} = \frac{100 \cdot 200^3}{12} = 66,67 \cdot 10^6 \text{ mm}^4$$

$$\sigma_{\max} = \frac{140 \cdot 10^6 \cdot 100}{66,67 \cdot 10^6}$$

$$\sigma_{\max} = 209,99 \frac{N}{\text{mm}^2}$$

9.

$$F_{fr} = F \frac{\mu}{\sin \alpha} = 2000 \frac{0,06}{\sin 60} = 138,56 \text{ N}$$

10.

$$P = M_{tfr} \cdot \omega$$

$$M_{tfr} = 2 \cdot v \cdot \mu \cdot F \cdot \bar{r} = 2 \cdot 2 \cdot 0,6 \cdot 60 \cdot 10^3 \cdot 0,3 = 43200 \text{ Nm}$$

$$\omega = \frac{2\pi n}{60} = \frac{2\pi \cdot 1500}{60} = 157,08 \frac{\text{rad}}{\text{s}}$$

$$P = 43200 \cdot 157,08$$

$$P = 6785,86 \text{ kW}$$

11.

$$\Sigma M = I \cdot \alpha$$

$$M_t - M_{tfr} = I \cdot \alpha \rightarrow M_t = I \cdot \alpha + M_{tfr}$$

$$M_t = 4,5 \cdot 20 + 15$$

$$M_t = 105 \text{ Nm}$$

12.

$$Q = m \cdot C \cdot (t_2 - t_1) = 10 \cdot 450 \cdot (600 - 20)$$

$$Q = 2610 \text{ kJ}$$

ΜΕΡΟΣ Β Τέσσερις (4) ερωτήσεις.
Κάθε ορθή απάντηση βαθμολογείται με οκτώ (8) μονάδες.

13.

$$(\alpha) \sin \beta = \frac{R - r}{O_1 O_2} \Rightarrow R = r + O_1 O_2 \cdot \sin \beta = 50 + 250 \cdot \sin 8^\circ = 84,79 \text{ mm}$$

$$D = 2 \cdot R = 2 \cdot 84,79 = 169,58 \text{ mm}$$

$$(\beta) L = \theta_1 \cdot r + \theta_2 \cdot R + 2 \cdot O_1 O_2 \cdot \cos 10^\circ$$

$$\theta_1 = 180 - 2\beta = 180 - 2 \cdot 8 = 164^\circ \Rightarrow \theta_1 = \frac{\pi}{180} \cdot 164 = 2,86 \text{ rad}$$

$$\theta_2 = 180 + 2\beta = 180 + 2 \cdot 8 = 196^\circ \Rightarrow \theta_2 = \frac{\pi}{180} \cdot 196 = 3,42 \text{ rad}$$

$$L = 2,86 \cdot 50 + 3,42 \cdot 84,79 + 2 \cdot 250 \cdot \cos 8^\circ$$

$$L = 928,11 \text{ mm}$$

14.

$$A_1 \cdot v_1 = A_2 \cdot v_2 \Rightarrow v_2 = \frac{A_1 \cdot v_1}{A_2}$$

$$A_1 = \frac{\pi \cdot d_1^2}{4} = \frac{\pi \cdot 0,075^2}{4} = 4,42 \cdot 10^{-3} \text{ m}^2$$

$$A_2 = \frac{\pi \cdot d_2^2}{4} = \frac{\pi \cdot 0,15^2}{4} = 17,7 \cdot 10^{-3} \text{ m}^2$$

$$v_2 = \frac{A_1 \cdot v_1}{A_2} = \frac{4,42 \cdot 10^{-3} \cdot 2}{17,7 \cdot 10^{-3}}$$

$$v_2 = 0,5 \frac{\text{m}}{\text{s}}$$

15.

$$(\alpha) \Sigma M_A = 0$$

$$-R_N \cdot 150 + F \cdot 750 = 0 \Rightarrow F = \frac{R_N \cdot 150}{750}$$

$$F_{fr} = \mu \cdot R_N \Rightarrow R_N = \frac{F_{fr}}{\mu} = \frac{900}{0,6} = 1500 \text{ N}$$

$$F = \frac{1500 \cdot 150}{750}$$

$$F = 300 \text{ N}$$

$$(\beta) M_{tfr} = F_{fr} \cdot r = 900 \cdot 0,1$$

$$M_{tfr} = 90 \text{ Nm}$$

16.

$$P = M_t \cdot \omega$$

$$\frac{M_t}{J} = \frac{\tau}{r} = \frac{G\theta}{\ell} \Rightarrow M_t = \frac{\tau \cdot J}{r}$$

$$J = \frac{\pi \cdot D^4}{32} = \frac{\pi \cdot 200^4}{32} = 157,08 \cdot 10^6 \text{ mm}^4$$

$$M_t = \frac{80 \cdot 157,08 \cdot 10^6}{100} = 125,66 \cdot 10^6 \text{ Nmm} = 125,66 \cdot 10^3 \text{ Nm}$$

$$\omega = \frac{2 \cdot \pi \cdot n}{60} = \frac{2 \cdot \pi \cdot 120}{60} = 4\pi \frac{\text{rad}}{\text{s}}$$

$$P = 125,66 \cdot 10^3 \cdot 4\pi$$

$$P = 1579,09 \cdot 10^3 \text{ W} = 1579,09 \text{ kW}$$

ΜΕΡΟΣ Γ: Δύο (2) ερωτήσεις.

Κάθε ορθή απάντηση βαθμολογείται με οκτώ (10) μονάδες

17.

(α) Υπολογισμός αντιδράσεων

$$\Sigma M_A = 0$$

$$-40 \cdot 1 + 30 \cdot 2 + 30 \cdot 3 - R_B \cdot 6 + 10 \cdot 7 = 0 \Rightarrow$$

$$R_B = \frac{-40 \cdot 1 + 30 \cdot 2 + 30 \cdot 3 + 10 \cdot 7}{6}$$

$$R_B = 30 \text{ kN}$$

$$\Sigma M_B = 0$$

$$-40 \cdot 7 + R_A \cdot 6 - 30 \cdot 4 - 30 \cdot 3 + 10 \cdot 1 = 0$$

$$R_A = \frac{40 \cdot 7 + 30 \cdot 4 + 30 \cdot 3 - 10 \cdot 1}{6}$$

$$R_A = 80 \text{ kN}$$

(β) Υπολογισμός Τ.Δ

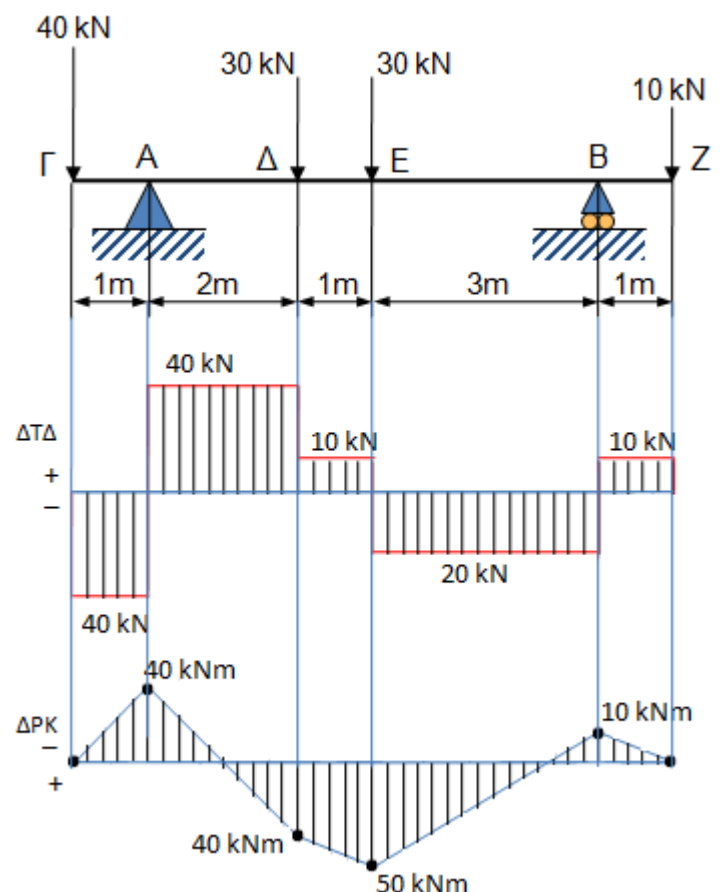
$$T\Delta_{(\Gamma-A)} = -40 \text{ kN}$$

$$T\Delta_{(A-\Delta)} = -40 + 80 = 40 \text{ kN}$$

$$T\Delta_{(\Delta-E)} = -40 + 80 - 30 = 10 \text{ kN}$$

$$T\Delta_{(E-B)} = -40 + 80 - 30 - 30 = -20 \text{ kN}$$

$$T\Delta_{(B-Z)} = 10 \text{ kN}$$



(γ) Υπολογισμός Ρ.Κ

$$PK_{\Gamma} = 0$$

$$PK_A = -40 \cdot 1 = -40 \text{ kNm}$$

$$PK_{\Delta} = -40 \cdot 3 + 80 \cdot 2 = 40 \text{ kNm}$$

$$PK_E = -40 \cdot 4 + 80 \cdot 3 - 30 \cdot 1 = 50 \text{ kNm}$$

$$PK_B = -10 \cdot 1 = -10 \text{ kNm}$$

$$PK_Z = 0$$

(γ) Υπολογισμός τάσης κάμψης

$$\frac{M_b}{I} = \frac{\sigma_{\max}}{y} = \frac{E}{R} \Rightarrow \sigma_{\max} = \frac{M_b \cdot y}{I}$$

$$M_{b\max} = 50 \text{ kNm}$$

$$I = \frac{bh^3}{12} = \frac{100 \cdot 300^3}{12} = 225 \cdot 10^6 \text{ mm}^4$$

$$\sigma_{\max} = \frac{50 \cdot 10^6 \cdot 150}{225 \cdot 10^6}$$

$$\sigma_{\max} = 33,33 \frac{N}{\text{mm}^2}$$

18.

(α)

$$I = m \cdot \frac{d^2}{8} = 50 \cdot \frac{0,4^2}{8} = 1 \text{ kgm}^2$$

(β) $\Sigma M = I \cdot \alpha$

$$M_t - M_{tfr} = I \cdot \alpha \Rightarrow M_t = I \cdot \alpha + M_{tfr}$$

$$\omega_2 = \omega_1 + \alpha \cdot t \Rightarrow \alpha = \frac{\omega_2 - \omega_1}{t}$$

$$\omega_1 = \frac{2 \cdot \pi \cdot 60}{60} = 2 \cdot \pi \frac{\text{rad}}{\text{s}^2}$$

$$\omega_2 = \frac{2 \cdot \pi \cdot 600}{60} = 20 \cdot \pi \frac{\text{rad}}{\text{s}^2}$$

$$\alpha = \frac{20 \cdot \pi - 2 \cdot \pi}{4} = 14,14 \frac{\text{rad}}{\text{s}^2}$$

$$M_t = 1 \cdot 14,14 + 4$$

$$\mathbf{M_t = 117,12 N}$$

$$(\gamma) \Sigma M = I \cdot \alpha$$

$$M_{tfr} = I \cdot \alpha \Rightarrow a = \frac{M_{tfr}}{I} = \frac{4}{1} = 4 \frac{\text{rad}}{\text{s}^2}$$

$$\omega_2 = \omega_1 - \alpha \cdot t \Rightarrow t = \frac{\omega_1 - \omega_2}{a}$$

$$\omega_1 = 20 \cdot \pi \frac{\text{rad}}{\text{s}^2}$$

$$\omega_2 = 0$$

$$t = \frac{20 \cdot \pi}{4}$$

$$\mathbf{t = 15,7 s}$$