

FAYOUM UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF CIVIL ENGINEERING

STRUCTURAL ANALYSIS AND MECHANICS (2A)
TIME : 3 HOURS

DATE : Jan. 11 , 2017
CLOSED BOOK EXAM.

Q1 (15 %)

For the bridge girder shown in Fig.(1); draw the influence lines for the following :

- (1) The reactions R_a, R_b, R_c, R_d (2) The bending moment M_g, M_h , (3) The shearing force $Q_{b \text{ left}}, Q_{b \text{ right}}$
(4) For a uniformly distributed dead load of 4 t/m and live load of 10 t/m as well as the train of loads shown ; calculate the maximum and minimum design values of the bending moment M_g .
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Q2(35%)

- (1) The beam shown in Fig. (2) is subjected to a U.D.L downward load of 1 t/m and an upward concentrated load of 20 t at the cantilever tip as shown. Draw the B.M.D and S.F.D for the beam.
(2) For section S-S just to the right of support b calculate the normal and shear stresses at points (n),(m) on the cross section shown in Fig.(2-a) , also draw the stress prism at point (m) only showing relevant axes.
(3) In order to strengthen the compression zone of the beam a channel section [was added and bolted to the upper flange of the beam as shown in Fig. (2-b) ; calculate the required pitch of the bolts considering single shear failure mode only to the bolts.
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Q3(30%)

- (3-a) Figure (3-a) shows a 3-D cantilever subject to the loads indicated at the free end. The cross section is solid circular with a radius of 30 cm. Find the stresses at point (n) located at section s-s at the fixed end , then draw the stress prism at that point.
(3-b) For the stress state shown in Fig.(3-b) find analytically the value and direction of the principal stresses and maximum shear . Verify the results using Mohr's circle.
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Q4 (20%)

Using the principle of Virtual Work ;

- (4-a) Calculate the horizontal displacement of point (d) For the three hinged frame shown in Fig.(4-a).
(4-b) Calculate the horizontal displacement of the roller support at (b) due to a 3 cm. settlement of the hinged support at (a) For the truss shown in Fig.(4-b) .