KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechanical Engineering

B. Sc. Engineering 4th Year Special Backlog Examination, 2016

ME 2211

(Mechanics of Solid)

Time: 3 Hours Total Marks: 210

N.B.: i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if missing any.
iv) Necessary table may be supplied on request.

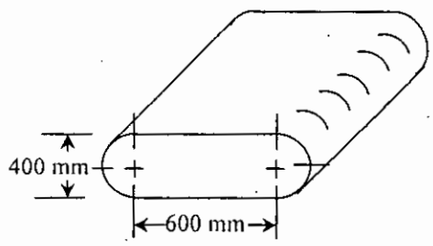
SECTION-A

1(a) Draw the stress-strain diagram and explain it completely. 08

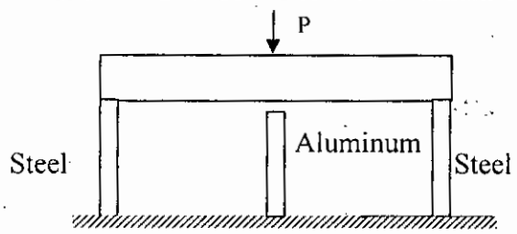
1(b) Define and explain the following terms: 09
(i) Bearing stress, (ii) Poison ratio, and (iii) Thin-walled pressure vessel.

18

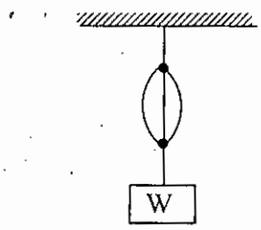
1(c) The tank shown is fabricated from 10 mm steel plate. Determine the maximum longitudinal and circumferential stress caused by an internal pressure of 1.2 MPa.



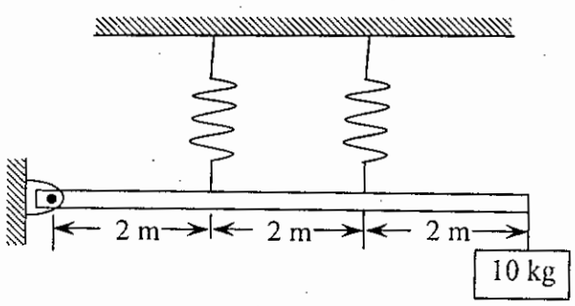
2(a) The rigid platform as shown has negligible mass and rests on two steel bars, each 250 mm long. The center bar is aluminum and 249.9 mm long. Compute the stress in the aluminum bar after the center load P = 400 kN has been applied. For each steel bar, the area is 1200 mm^2 and E = 200 GPa. For the aluminum bar, the area is 2400 mm^2 and E = 70 GPa. 18



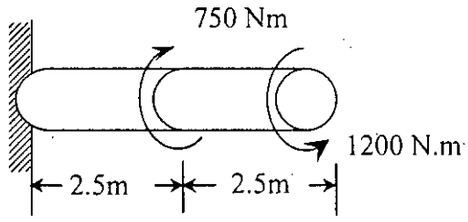
2(b) Three steel wires as shown, each 32 mm^2 in area are used to lift a load W = 750 kg. Their unstressed lengths are 22.8542 m, 22.8572 m and 22.8603 m. What stress exists in the longest wire? E_s = 200 GPa. 17



3(a) A rigid bar hinged at one end is supported by two identical springs as shown. Each spring consists of 20 turns of 10 mm wire having a mean diameter of 150 mm. Compute the maximum shearing stress in the springs. Neglect the mass of the rigid bar. 17

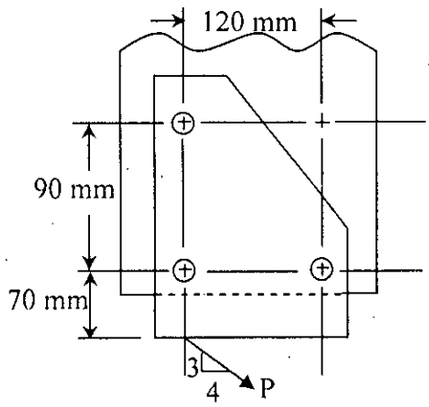


3(b) A solid steel shaft is loaded as shown in figure. Using G = 83 GPa, determine the required diameter of the shaft if the shearing stress is limited to 60 MPa and the angle of rotation at the free end is not to exceed 4°. 18



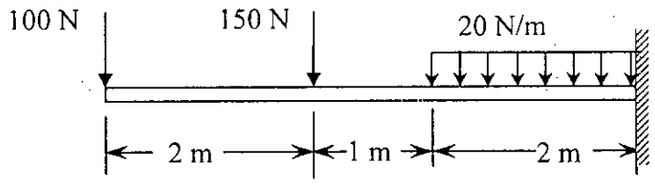
4(a) Select the lightest W shape that will support an axial load of 360 kN on an effective length of 4.6 m. Use AISC column specifications with σ_{yp} = 250 MPa. 18

4(b) For the riveted connection shown, determine the allowable load *P*, if the shearing stress in the 25 mm rivets is limited to 140 MPa. 17

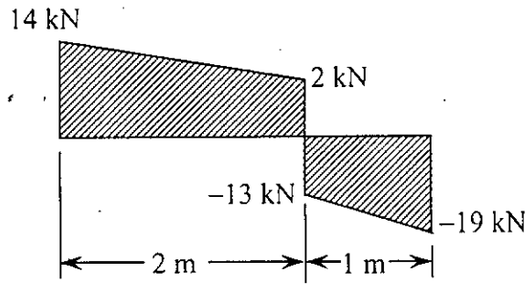


SECTION-B

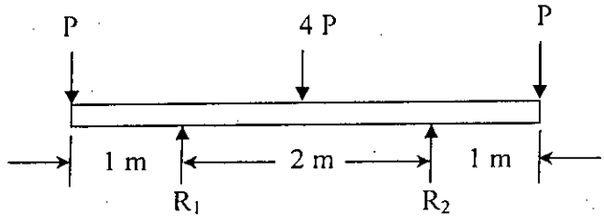
5(a) Write shear and moment equations, draw the shear and moment diagram for the beam shown. Give numerical values at all changes of loading positions. 18

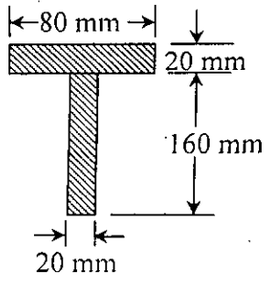


5(b) Draw the load and moment diagrams for the shear force diagram as shown. 17

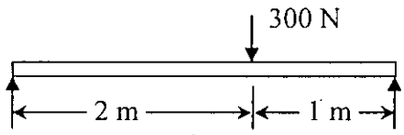


6(a) A 'T' beam supports the three concentrated loads as shown. Show that the NA is 70 mm from the top and that $I_{NA} = 15.52 \times 10^6\ mm^4$. Then use these values to determine the maximum value of P so that $\sigma_t \leq 30$ MPa and $\sigma_c \leq 70$ MPa. 18

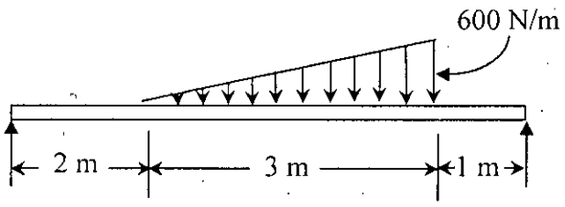




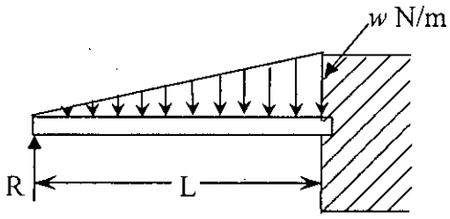
6(b) A concentrated load 300 N is supported as shown. Determine the equations of the elastic curve between each change of load point and the maximum deflection in the beam. 17



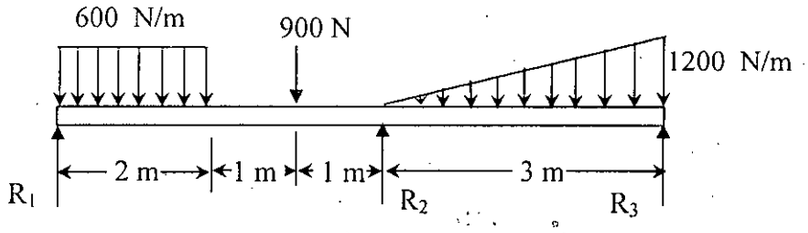
7(a) For the beam shown, compute the moment of area of the moment diagram about the left end. 15



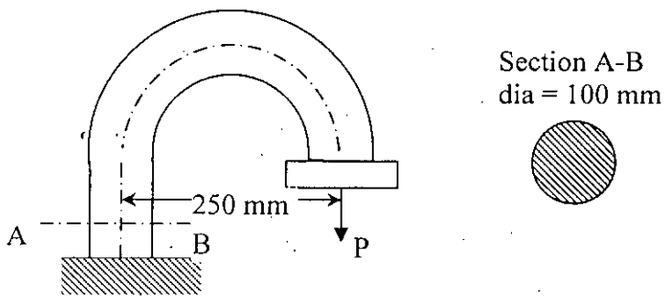
7(b) Compute the reaction R and sketch shear and moment diagrams for the propped beam as shown. 20



8(a) The continuous beam as shown is supported on rigid foundations. Determine the bending moments in the beam over the supports. 18



8(b) Determine the largest load P that can be supported by the circular steel bracket as shown, if the normal stress on section A-B is limited to 80 MPa. 17



KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechanical Engineering

B. Sc. Engineering 4th Year Backlog Examination, 2016

ME 4213(Old)

(Fluid Mechanics III)

Time: 3 Hours. Total Marks: 210

N.B. i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
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SECTION - A

1(a) What is meant by negative slip? Deduce the expression of work saved by fitting an air vessel in a reciprocating pump. 18

1(b) A single acting reciprocating pump runs at 70 rpm. The diameter of the plunger is 0.2m and crank radius is 0.19m. The suction pipe is 10cm in diameter and 7.0m long. Calculate the maximum permissible value of suction lift. 17

2(a) Discuss how kinetic energy converted to pressure energy in the volute casing? 10

2(b) Deduce the expression of least diameter of a centrifugal pump. 10

2(c) Determine the power required to drive a centrifugal pump which delivers 36 liters of water per second to a height of 20m through a 130mm diameter and 105m long pipeline. The overall efficiency of the pump is 70% and Darcy's f=0.03 for the pipeline. 15

3(a) Show that for maximum hydraulic efficiency of a Pelton wheel the jet velocity is half the bucket velocity. 18

3(b) Describe the function of surge tank. 07

3(c) Explain with neat sketch the governing of a hydraulic turbine. 10

4(a) Derive the expression of pressure regained by fitting a draft tube in a turbine. 18

4(b) A Kaplan turbine produces 10^4 kW under a net head of 31m with an overall efficiency of 91%. The hub diameter is 0.4 times the outer diameter of the runner. Determine; 17

(i) The diameters,
(ii) The speed of the turbine assuming the speed ratio K_u=1.5 and flow ratio=0.65.

SECTION - B

5(a) Show that circulation around a contour is equal to the product of the vorticities within area of the contour. 07

5(b) Deduce the expression of ψ and φ of a doublet flow and hence show graphically the stream function and velocity potential. 13

5(c) Derive the expression of stream function and velocity potential for rectilinear flow over a Rankine half body. 15

6(a) What are the physical significance of flow net? 10

6(b) What are the conditions of formation of a doublet? 10

6(c) Determine the flow rate between the points (4.7,2.7) and (6.3,4.9) for flow field $\psi=8x^3y^2+5x^2y$. Also determine the velocity potential for the flow field. 15

7(a) What is economic section of an open channel flow? Deduce the expression of economic section for a trapezoidal channel. 18

7(b) A trapezoidal channel has a bottom width of 5m and side slopes of 3 horizontal to 1 vertical. If the depth of flow is 1.5m at a discharge of $12m^3$/sec, determine; 17

(i) The specific energy and
(ii) The critical depth of flow.

8(a) Classify hydraulic jump based on Froude number. Explain with neat sketch. 15

8(b) Derive the expression for the ratio of conjugate depths in terms of Froude number for a rectangular channel. 20