Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-I & II Remedial Examination Nov/ Dec. 2010

Subject code: 110010 **Subject Name: Mechanics of Solids**

Date: 08 / 12 / 2010 **Time: 10.30 am – 01.00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Programmable calculators are not allowed.**

Q.1 **(a)** Define force and explain different type of force system with figures. **03**

(b) Determine magnitude and direction of resultant force of the force system shown in **figure 1.** **04**

(c) A stepped bar made of steel, copper and brass is under axial force as shown in **figure 2** and is in equilibrium. The diameter of steel is 12mm, diameter of copper is 16mm and the diameter of brass is 20mm.Determine (i) Magnitude of unknown force P (ii) stresses in each material and (iii) Total change in length of the bar. Take E_{steel} = 200GPa, E_{copper} =100GPa and E_{brass} = 80GPa **07**

Q.2 **(a)** Explain the terms Hardness, Toughness and Ductility. **03**

(b) Sketch the Characteristic Stress - Strain curve for mild steel under tension and show salient points on it. **04**

(c) In a differential axle and wheel it is observed that an effort of 70 N is required to lift a load of 300 N and an effort of 120 N is required to lift a load of 600 N. If the diameter of Effort Wheel is 200 mm, Diameters of larger and smaller axles are 100 mm and 50 mm respectively, determine (i) Velocity ratio (ii) Law of machine (iii) Effort required to lift a load of 1000 N (iv) Ideal effort to lift the load 1000 N (v) Maximum Efficiency. **07**

OR

(c) Determine the support reactions of the beam shown in **figure 3.** **07**

Q.3 **(a)** State Pappus Guldinus Theorem for surface of revolution. **03**

(b) Determine the location of centroid and moment of inertia of the given lamina in **figure 4** about centroidal X axis. **05**

(c) Determine forces in the member of the plane truss shown in **figure 5.** **06**

OR

Q.3 **(a)** State assumptions made in the theory of pure bending. **03**

(b) Determine the magnitude direction and position of resultant force of the force system given in **figure 6** with reference to point A **05**

(c) Draw shear force and bending moment diagram for the beam shown in **figure 7** **06**

Q.4 **(a)** Sketch shear stress distribution across the following sections. **04**

(i) Rectangular section (ii) Circular section

(iii) T section (iv) I section

(b) A ladder 6 m long ,rests on horizontal ground and leans against a smooth vertical wall making an angle of 20^0 with the wall. Its weight is 1000 N and it is on the point of sliding when a man weighing 500 N stands on it at a distance of 2.2 m from the foot of the ladder. Calculate the coefficient of friction. **05**

(c) Determine the bending stress distribution for the beam shown in **figure 8.** If the cross section of the beam is 200mm X300mm. Sketch the bending stress diagram. **05**

OR

Q.4 **(a)** Derive the relation between bulk modulus and modulus of elasticity. **04**

(b) A steel bar ABC having 25mm diameter and 500mm length of AB and 16mm diameter and 350mm length of BC is rigidly held between two supports at A and C. If the temperature is raised by 30^{o} Celsius determine the stresses developed in parts AB and BC. Take E= 200GPa and $\acute{\alpha} = 12 \times 10^{-6} / {}^{o}C$ **05**

(c) Prove that the maximum shear stress in a circular section of a beam is 4/3 times of average shear stress. **05**

Q.5 **(a)** Explain principal planes and principal stresses. **03**

(b) A flitched beam consists of two timber joists 150mm wide and 300mm deep with a steel plate 10mm thick and 250mm deep placed symmetrically between them as shown in **figure 9.** If the stress in steel and timber is not to exceed $140N/mm^2$ and $6N/mm^2$. Find the moment of resistance of the section. Take $E_S = 20\ E_T$ **05**

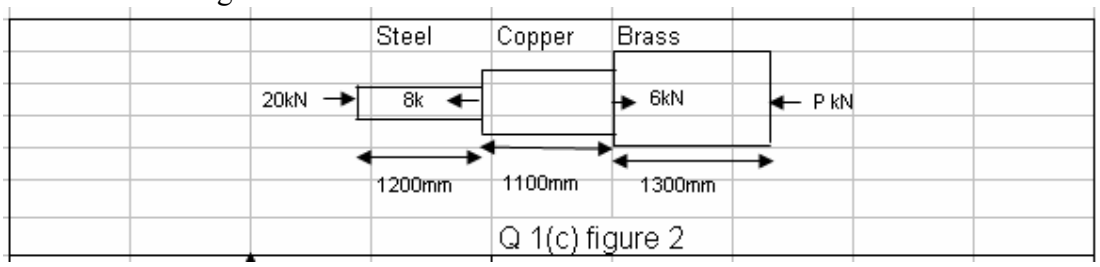
(c) A point in a strained material is subjected to a tensile stress of $120N/mm^2$ and a compressive stress of $60N/mm^2$ acting at right angles to each other . determine the Normal ,tangential and resultant stress on a plane inclined at 30^0 in anticlockwise direction with the direction of compressive stress. **06**

OR

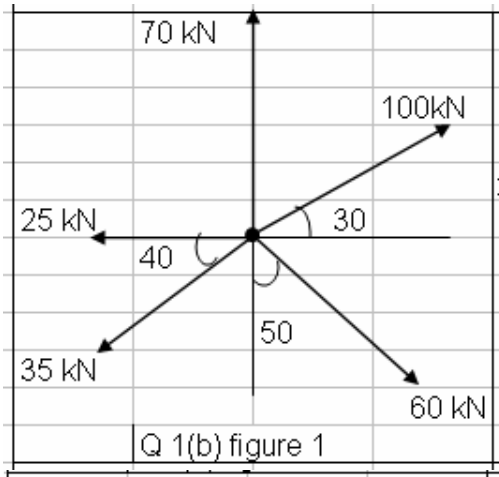
Q.5 **(a)** Define Friction, Coefficient of friction and angle of repose. **03**

(b) At a point in a strained material two mutually perpendicular tensile stresses of 420 N/mm^2 and 280 N/mm^2 are acting. There is also a clockwise shear stress of 200 N/mm^2 . Determine the values of principal stresses and location of principal plane. **05**

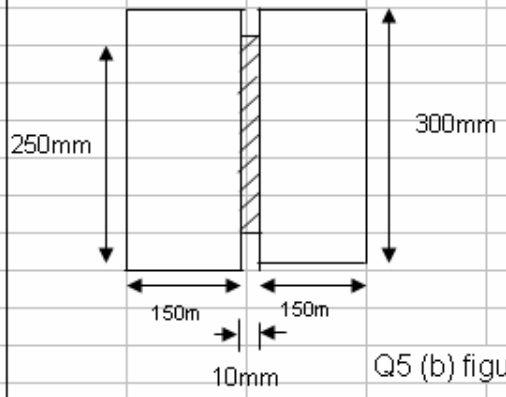
(c) A 15^0 wedge 'A' is pushed to move block 'B' weighing 1200 N as shown in **figure 10.** Determine the minimum force 'P' required to move the block if the coefficient of friction for all contact surfaces is 0.25. Neglect the self weight wedge. **06**



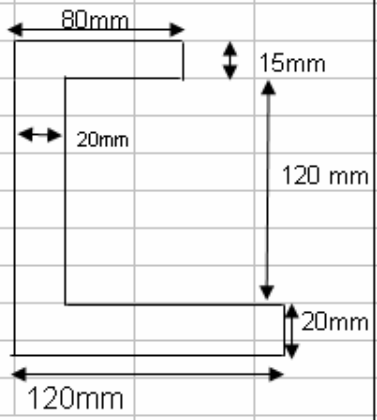
Q 1(c) figure 2



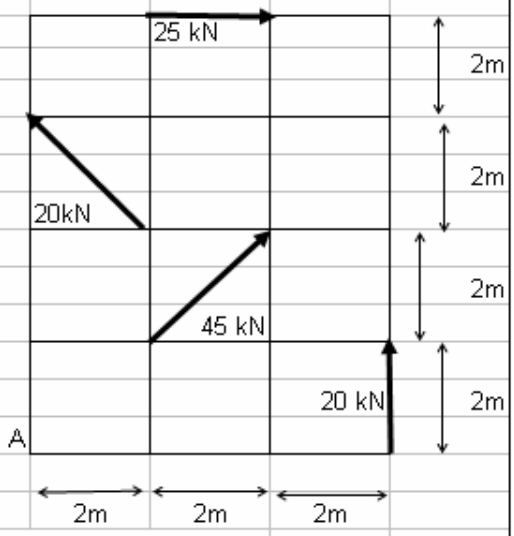
Q 1(b) figure 1



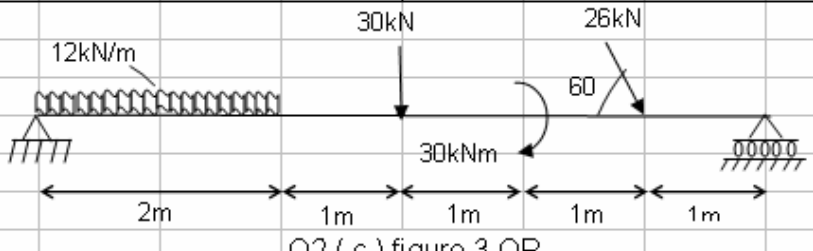
Q5 (b) figure 9



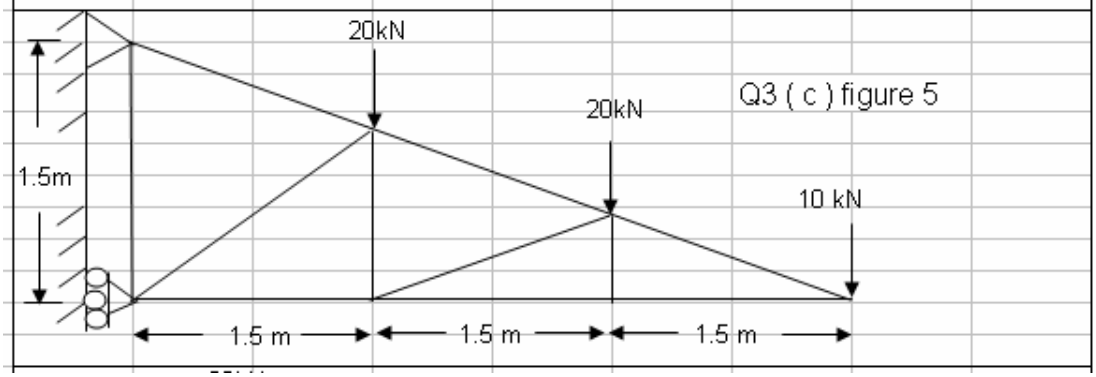
Q 3 (b) figure 4



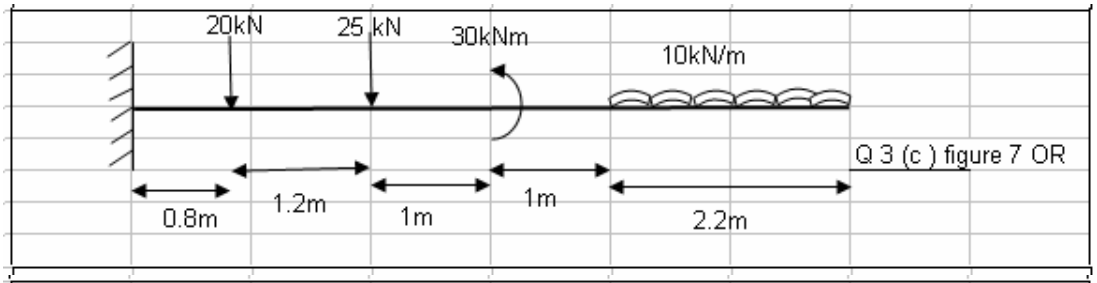
Q 3 (b) figure 6 OR

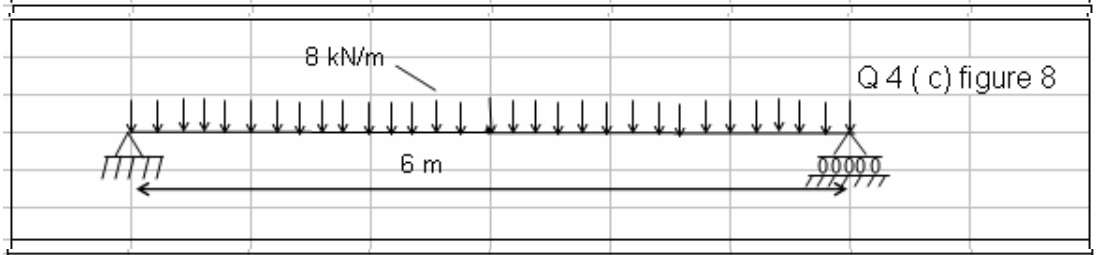


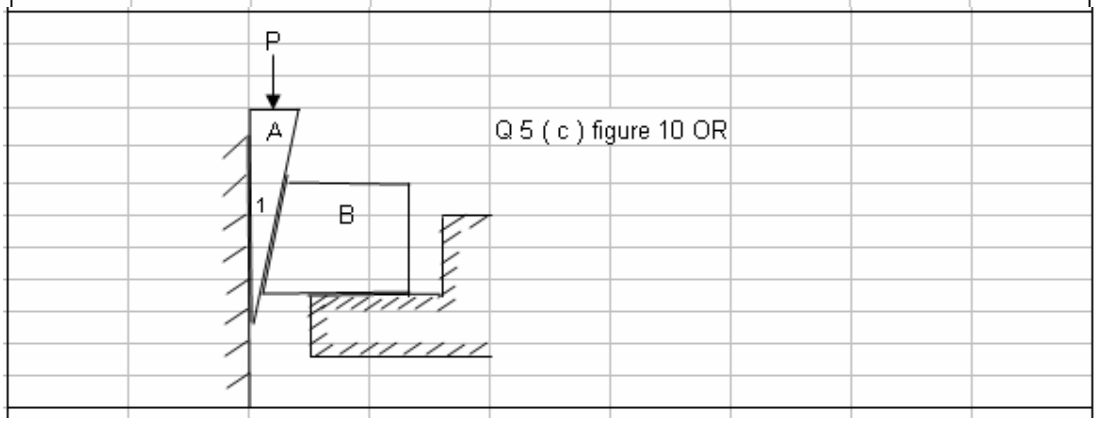
Q2 (c) figure 3 OR



Q3 (c) figure 5


20kN
25 kN
30kNm
10kN/m
Q 3 (c) figure 7 OR
0.8m
1.2m
1m
1m
2.2m


8 kN/m
Q 4 (c) figure 8
6 m


P
A
1
B
Q 5 (c) figure 10 OR

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