Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-III Examination December 2009

Subject code: 130103

Subject Name: Analysis of Mechanism and Machine Element

Date:29 /12/2009 **Time: 11.00 am – 1.30 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Explain Free body diagram of a mechanism with neat sketch. **02**

(b) Sketch the free body diagram of each part of the mechanism shown in **Fig. 1,** only show the location and direction of the forces and torque but not magnitude. **04**

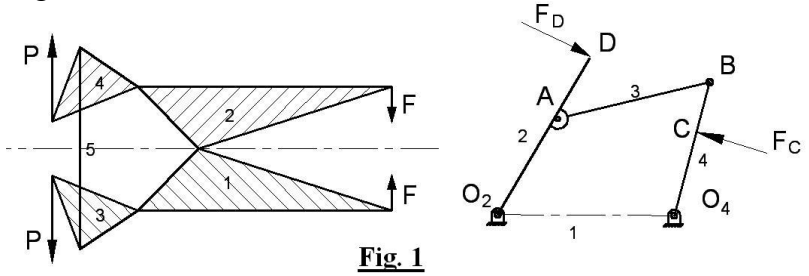

Fig. 1

(c) What torque must be applied on link 2 of the mechanism shown in **Fig. 2,** to maintain static equilibrium? **08**

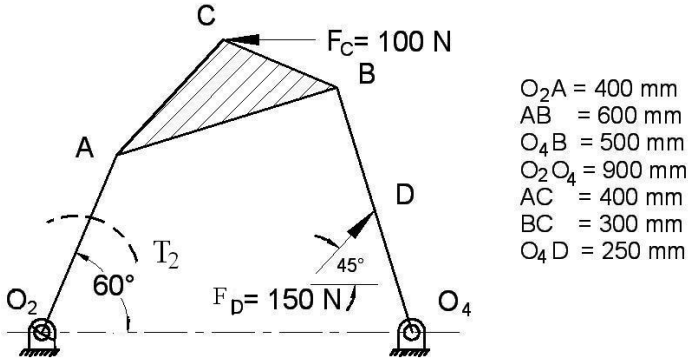

Fig. 2

Q.2 **(a)** State and explain D'Alembert's principle. What do you mean by equivalent off inertia force? Deduce the expression of offset inertia force distance *'h'* in the form of $h=(I_G\alpha) / (mA_G)$, all notations are as per standard. **07**

(b) Define: Element, Pair, Chain, Mechanism and Machines. And differentiate between mechanism and machines. **07**

OR

(b) With help of neat sketches explain different types of kinematic pairs. **07**

Q.3 **(a)** For the mechanism shown in **Fig. 3,** draw velocity diagram and find out absolute velocity of point E and rubbing velocities at all the joint for equal pin radii of 15 mm. Take angular velocity of crank AB equal to 15 rad / s in counter clockwise direction. **07**

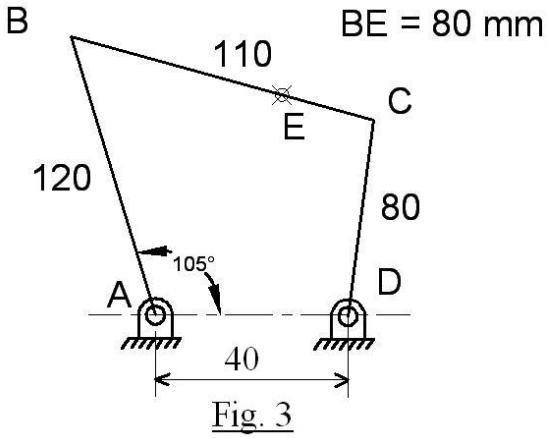

Fig. 3

(b) For the mechanism shown in **Fig. 3** (Q-3, a), draw acceleration diagram and find out the absolute acceleration of point C and E. **07**

OR

Q.3 **(a)** With help of neat sketches explain inversions of four-bar mechanism. **07**

(b) What do you mean by I center and Centrode? With help of sketch explain Kennedy's theorem. **07**

Q.4 **(a)** For a single cylinder reciprocating engine give, expression for (i) Piston effort (ii) Crank effort and (iii) Turning moment on crank shaft. **06**

(b) The effective steam pressure on the piston of a vertical steam engine is 300 kN/ mm^2. When the crank is 40^0 from the inner-dead centre on the down stroke. The crank length is 250 mm and that of connecting rod is 1000mm. The diameter of the cylinder is 650 mm. What will be the torque on the crank shaft if the engine speed is 300 rpm and the mass of the reciprocating parts 250kg? **08**

OR

Q.4 **(a)** Explain dynamically equivalent system. **02**

(b) What is flywheel? What is its use? **02**

(c) A horizontal gas engine running at 210 rpm has a bore of 220 mm and a stroke of 420 mm. The connecting rod is 900 mm long and the reciprocating parts weight 24 kg. When the crank has turned through an angle of 30^0 from the inner dead centre, the gas pressure on the cover and the crank sides are 500 kN / m^2 and 60 kN / m^2. The diameter of piston rod is 40 mm. Determine, **10**

(i) turning moment on the crank shaft,

(ii) thrust on the bearing,

(iii) Acceleration of the flywheel, which has a mass of 8 kg and radius of gyration of 600 mm. While the load is 22kN.

Q.5 **(a)** Explain maximum principle and maximum shear stress theory. Mention the type of material for which they are applicable. **05**

(b) Show that for transmitting same torque the weight per unit length is less in case of hollow shaft than solid shaft. **04**

(c) Give the expression of length of a square key in term of the diameter of the shaft assuming both key and shaft are of same material and width and thickness of the key is one-forth of the shaft diameter. **05**

OR

Q.5 **(a)** The dimension of an overhang crank is shown in **Fig. 4.** The force P acting at the crank pin is 250N. The crank is made of steel 40C8 (S_{yt} = 400 N / mm^2) and the factor of safety is 4. Using Maximum shear stress theory of failure, determine the diameter at section- xx. **08**

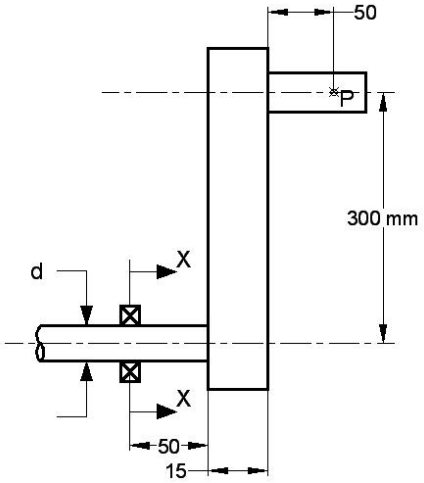

Fig. 4

(b) A welded joint, as shown in **Fig. 5,** is subjected to an eccentric load of 2500 N. Find the size of the weld, if the maximum shear stress in the weld is not to exceed 50 N / mm^2. **06**

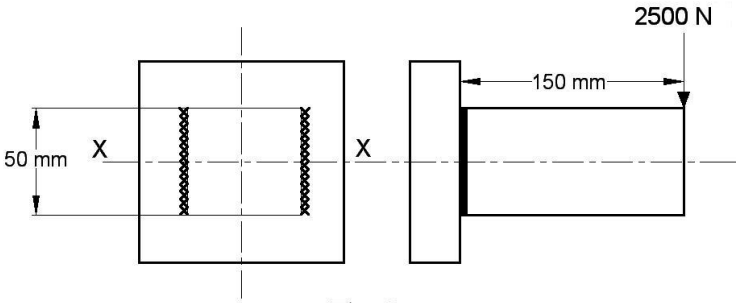

Fig. 5

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