# INTERNATIONAL CENTRE FOR APPLIED SCIENCES
# MAHE, MANIPAL

**B.Sc. (Applied Sciences) in Engg.**

**End – Semester Theory Examinations – May 2021**

**IV SEMESTER – THEORY OF MACHINES (IME 241)**

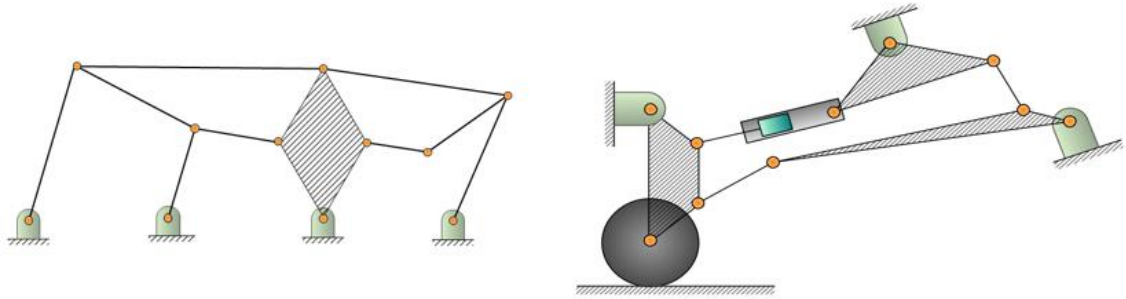
**(BRANCH: MECHANICAL)**

**Time: 3 Hours** **Date: 12 May 2021** **Max. Marks: 50**

- ✓ **Answer All questions.**
- ✓ **Missing data, if any, may be suitably assumed**

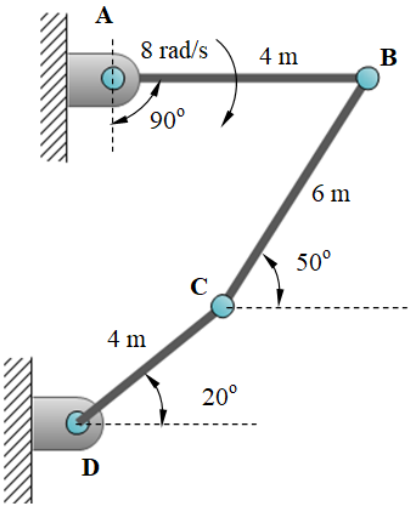
**1A** With help of neat sketches discuss different types of constrained motion. **(3)**

**1B** Find the total number of degrees of freedom for the given mechanisms shown below. **(3)**

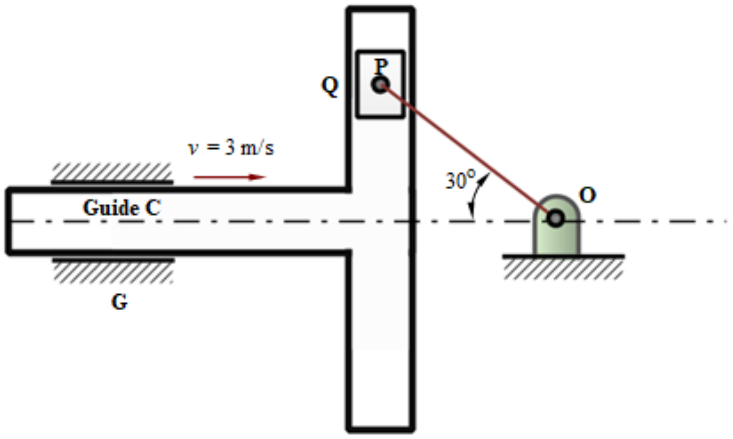


**1C** Explain the Grashoff's constraint for a four bar link mechanism and with help of neat sketch discuss coupling rod locomotive mechanism. **(4)**

**2A** Link AB in the mechanism shown in figure has an angular velocity of 8 rad/s clockwise. At the position shown, determine $\omega_{BC}$ and $\omega_{CD}$ using the instantaneous center method. **(5)**



**2B** Figure shows a Scotch Yoke mechanism. At the instant shown in figure, the guide C moves with a velocity 3 m/s (directed towards right). The length link OP is 200 mm. Using the relative velocity method find (i) Velocity of block P, (ii) Angular velocity of the link OP, (iii) Centripetal acceleration of link OP (acceleration of point P with respect to O) **(5)**




**3A** Cam with 30 mm minimum radius is to give the motion to a roller follower of 20 mm diameter. **(2.5)**
(i) Cam lift =40 mm during 120° of cam rotation with simple harmonic motion
(ii) Dwell for the next 70°
(iii) During next 90° of cam rotation, the follower returns to its original position with uniform acceleration and deceleration and dwells for remaining duration.
Draw the displacement diagram for the follower motion

**3B** For the displacement diagram drawn in question 3a, draw the Cam profile. **(5)**

**3C** Derive an expression to find the centrifugal tension in a belt drive. **(2.5)**

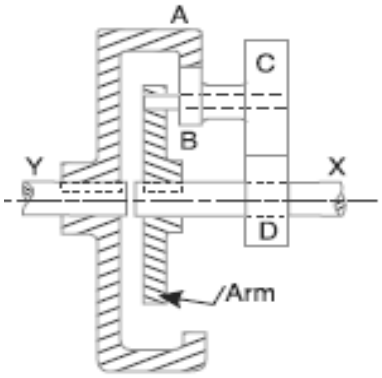
**4A** Derive the expression for the minimum number of teeth to avoid interference in involute tooth gears. **(4)**

**4B** Two 20° involute gears have a module module of 4 mm. The number of teeth in gear 1 and gear 2 are 40 and 24 respectively. If the gear 2 rotates at 600 rpm, determine the velocity of sliding when the contact is at the tip of the gear 2. Take adendum equal to one module. (assume smaller gear is the driver). Also find the maximum sliding velocity **(4)**

**4C** Briefly discuss the torque analysis in an epicyclic gear train. **(2)**

**5A** An over drive for a vehicle consists of an epicyclic gear train, as shown in Figure with compound planets B-C. B has 15 teeth and meshes with an annulus A which has 60 teeth. C has 20 teeth and meshes with the sunwheel D which is fixed. The annulus is keyed to the propeller shaft Y which rotates at 740 rad /s. The spider which carries the pins upon which the planets revolve, is driven directly from main gear box by shaft X, this shaft being relatively free to rotate with respect to wheel **(5)**

D. Find the speed of shaft X, when all the teeth have the same module. When the engine develops 130 kW, what is the holding torque on the wheel D?




**5B** An open belt running over two pulley 1.5 m and 1 m diameter connects two parallel shafts 4.8 m apart. The initial tension in the belt when stationary is 3000 N. If smaller pulley is rotating at 600 rpm and coefficient of friction between the belt and pulley is 0.3. Determine the power transmitted taking centrifugal tension into account. The mass of the belt is given as 0.6703 kg/m length. **(3.5)**

**5C** What is meant by a contact ratio? Explain how the contact ratio is an important parameter for the smooth function of a gear. **(1.5)**

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