sem III / Prod / 14-06-10 / Theory of machines

Con. 3027–10. **AN–2473**

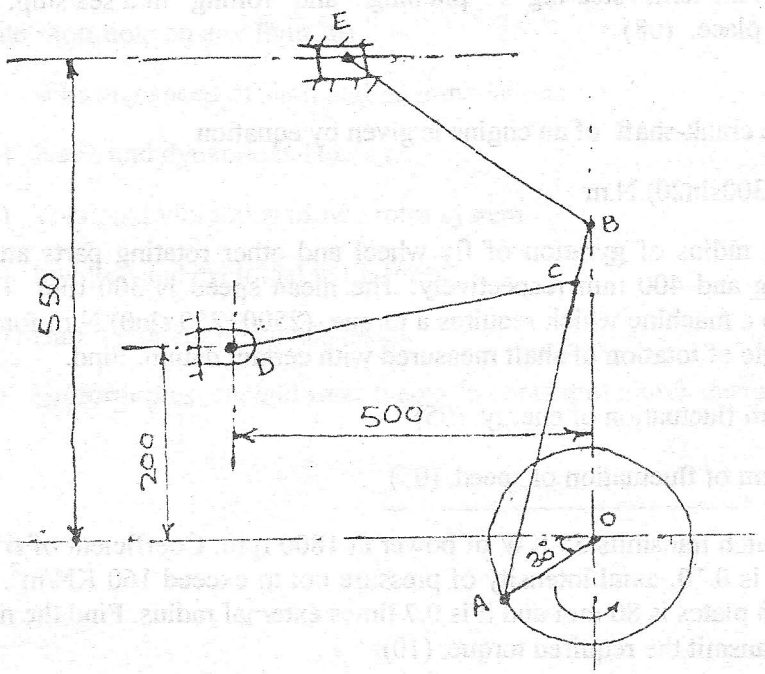
(4 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from the remaining **six** questions.
(3) Assume **suitable** data if **necessary clearly** stating the assumption.
(4) Draw **neat** and **labelled sketches**. Use drawing sheets if **necessary**.
(5) **Figures** to the **right** indicate **full** marks.

Q1. a) For the mechanism shown in the figure, the crank OA rotates at 150 rpm anti-clockwise . The dimensions of various links are: OA=150mm, AB =550mm, AC= 450mm and CD=500mm and BE = 350 mm. At the instant when the crank makes an angle of 60^0 with the vertical, determine the angular velocity of the link CD and linear velocity of the slider E by

1) Relative velocity method. (06)
2) Instantaneous centre method . (04)

b) Determine the linear acceleration of the slider E (10)



Q.2. a) what is engine indicator diagram? Describe any one of the indicator mechanism. (05)

b) state and explain Davis steering gear mechanism and show that it satisfies the condition of correct steering, (05)

c) what do you mean by instantaneous centre of rotation? Explain how the velocity of a point on a link is determined by instantaneous centre method. (05)

d) Explain the principle and working of whitworth quick return mechanism with a neat sketch. (05)

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Q.3. a) draw a cam profile to drive an oscillating follower to the specifications given below

1} follower to move outward through a angular displacement of 20^0 during first 120^0 rotation of cam.

2) Follower to remain in its position during next 60^0 of cam rotation

3) follower to come back to its initial position during next 120^0 rotation of cam.

4) follower to remain in the dwell position for the remaining angle of cam rotation.

The distance between the pivot centre and the roller centre = 120 mm.

The distance between the pivot centre and the cam axis = 130 mm.

Minimum radius of cam = 40 mm.

Radius of roller = 10 mm.

Inward stroke of the follower takes place with uniform velocity and the outward stroke with simple harmonic motion. (12)

Sketch and explain the term "steering ", "pitching " and "rolling" in a sea ship. About which axes do these take place. (08)

Q.4. a) the torque at the crank-shaft of an engine is given by equation

$T = (2500+300\sin 2\theta)$ N.m

The mass and the radius of gyration of fly wheel and other rotating parts attached to the engine are 250 Kg and 400 mm respectively. The mean speed is 300 rpm. The engine is directly coupled to a machine which requires a torque $(2500+250\sin\theta)$ N.m for its operation where θ is the angle of rotation of shaft measured with certain datum. Find.

1) maximum fluctuation of energy. (05)

2) coefficient of fluctuation of speed. (05)

b) a multi plate clutch transmits 55 KW of power at 1800 rpm. Coefficient of friction for the frictional surfaces is 0.10. axial intensity of pressure not to exceed 160 KN/m^2. The internal radius of the clutch plates is 80 mm and it is 0.7 times external radius. Find the number of the plates needed to transmit the required torque. (10)

Q. 5. a) Following data refers to the spur gears in mesh : module m = 5 mm, pressure angle $\varphi = 20^0$, pinion teeth t = 20, gear teeth T = 60, addendum = module.

Check wheather the gears are subjected to interference also find the contact ratio. (10)

b) a vertical steel shaft of 15 mm diameter is held in bearings which are 1 m apart. The shaft carries at its middle a rotor of mass 15 kg. The eccentricity of the centre of gravity from the center of the rotor is 0.3 mm and the permissible stress is 70 MN/m^2.

Find the critical speed of shaft and the range of speeds over which it is unsafe to run the shaft. $G = 200GN/m^2$. (10)

Q.6. a) an aeroplane makes half circle of 50 mm radius towards left when flying at 200 km/hr. The rotary engine and propeller of the plane has a mass of 400 kg with a radius of gyration 300 mm. The engine runs at 2400 rpm clockwise when viewed from rear.

Find the gyroscopic couple on the plane and state its effect. What will be the effect on aeroplane when it turns to right? (10)

b) Four masses A,B,C and D are completely balanced. Masses C and D make angles of 90^0 and 195^0, respectively with B in the same sense. The rotationg masses have the following properties

$M_b = 25$ kg $\quad r_b = 200$ mm

$M_c = 40$ kg $\quad r_c = 100$ mm

$M_d = 35$ kg $\quad r_d = 180$ mm

$r_a = 150$ mm.

Plane B and C are 250 mm apart. Determine the mass of A and its angular position also the position of A and B (10)

Q.7. write short note on any four(20) : –

a) Whirling speed of shaft and its implications.

b) Static and dynamic balancing.

c) Torsional vibrations of two rotor system.

d) Involute and cycloidal tooth form.

e) Hart's straight line mechanism.

f) Uniform pressure and wear theory in context of clutch design.