CBCS SCHEME

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21AU44

# Fourth Semester B.E. Degree Examination, June/July 2023
## Theory of Machines

Time: 3 hrs. Max. Marks: 100

**Note:** ***Answer any FIVE full questions, choosing ONE full question from each module.***



### Module-1

1 a. With a neat sketch, explain crank and slotted lever mechanism. **(08 Marks)**

b. Define the following terms with example
i) kinematic pair ii) kinematic chain iii) mechanism iv) structure
v) machine vi) inversion. **(09 Marks)**

c. Determine the mobility of the mechanism. Given below :

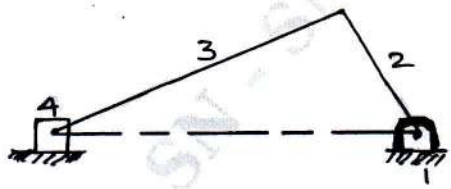



Fig Q1(c) **(03 Marks)**

**OR**

2 a. Define Linear and angular acceleration. **(04 Marks)**

b. A four bar mechanism ABCD is made up of four links, pin jointed at ends. AD is a fixed link which is 180mm long. The links AB, BC and CD are 90mm, 120mm and 120mm long respectively. At certain instant, the link AB makes on angle of 60° with the link AD. If the link AB rotates at a uniform speed of 100 rpm clockwise determine : i) Angular velocity of the links BC and CD ii) Angular Acceleration of the links CD and CB. **(16 Marks)**

### Module-2

3 a. A Spur gear of 20° pressure angle running at 200 rpm drives another gear at a speed of 100 rpm. The centre distance between the two gears is 300mm and module is 5mm. determine : i) pitch circle radius of pinion ii) pitch circle radius of gear iii) Numbers of teeth on gear iv) number of teeth on pinion v) Base circle radius of pinion vi) Base circle radius of Gear vii) circular pitch viii) tooth thickness on pitch circle. **(10 Marks)**

b. An Epicyclic gear train is constructed as follows. A fixed annular wheel A and a smaller concentric wheel 'B' are connected by a compound wheel $A_1 - B_1$. $A_1$ gearing A. $B_1$ gearing with B. The compound wheel revolves on a stud which is carried around on arm which revolved about the axis A and B. 'A' has 130 teeth, B = 20 teeth, $B_1$ = 80 teeth, pitch of A and $A_1$ being twice that of pitch of 'B' and $B_1$. How many revolution 'B' will make for one revolution of arm. (Tabular method). **(10 Marks)**

**OR**

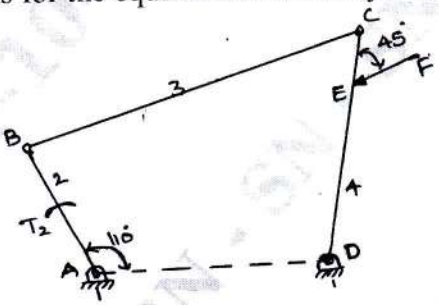
4 a. Define the following as applied to a cam i) Base circle ii) Pitch circle iii) Pressure angle iv) Stroke v) Prime circle vi) Cam angle. **(06 Marks)**

b. Draw the cam profile for cam with roller reciprocating follower. The axis of the follower passes through the axis of cam. Particular of the cam and follower are the following. Roller diameter = 20m, minimum radius of cam = 25mm. Total lift = 30mm. The cam has to lift the follower with SHM during 180° of cam rotations, then allow the follower to drop suddenly half way and further return with uniform velocity during the remaining 180° of cam rotation. The cam rotates in ant clockwise direction. **(14 Marks)**

## Module-3

5 a. With neat sketches, discuss the static equilibrium of the following :
i) Two force members ii) Two forces and a torque members iii) Three force members. **(06 Marks)**

b. In the Fig Q5(b) four bar mechanism is shown. Calculate the required value of $T_2$ and various forces on links for the equilibrium of the system.




F = 2000N
AD = 215mm
AB = 200mm
BC = 370mm
DC = 350mm
CE = 100mm

Fig Q5(b)

**(14 Marks)**

**OR**

6 a. Explain inertia forces on a engine mechanism (slider crank mechanism). **(10 Marks)**

b. When the crank is 45° from the inner dead centre on the down stroke. The effective steam pressure on the piston of a vertical steam engine is 2.5bar. The diameter of the cylinder = 0.75m. Stroke of the piston = 0.50 m and length of connecting rod = 1m. Determine the torque on the crank shaft. If the engine runs at 350 rpm and shaft. If the engine runs at 350 rpm and the mass of reciprocating parts is 200 Kg. **(10 Marks)**

## Module-4

7 a. Derive the equation for size of flywheel or hoop stress developed in a flywheel. **(10 Marks)**

b. A vertical double acting steam engine develops 73.6 kilo –watts at 250rpm. The maximum fluctuation of energy is 30% of WD/stroke. The maximum and minimum speeds are not to very more than 1% on either side of mean speed; find the mass of flywheel required. If the radius of gyration is 0.6m. **(10 Marks)**

**OR**

8 a. Derive an expression for speed and height of the porter governor by resolution of forces. **(10 Marks)**

b. The mass of each ball of a spring controlled governor is 1.4Kg. The bell crank level has its vertical arm 90mm and horizontal arm 40mm. The distance of fulcrum from the axis of rotation is 45mm. the sleeve has mass of 7.5Kg. The sleeve begins to rise at 220 rpm. The rise of the sleeve for 6% rise in speed is 8mm. Find the initial thrust on the spring and its stiffness. **(10 Marks)**

## Module-5

9 a. Derive an expression for total frictional torque of flat pivot bearing considering uniform pressure. **(10 Marks)**

b. The thrust on the propeller shaft of a marine engine is taken by 8 collars whose external and internal diameters are 650mm and 400mm respectively. The maximum thrust pressure is 0.5PMPa. The coefficient of friction between the shaft and collars is 0.04. If the shaft rotates at 120rpm, find 1) Assuming uniform pressure i) Total thrust on the collars ii) Power absorbed by friction at the bearing 2) Assuming uniform wear i) Total thrust on the collars ii) Power absorbed by friction at the bearing. **(10 Marks)**

**OR**

10 a. Derive an expression for length of an open belt drive. **(10 Marks)**

b. A line shaft is driven by an electric motor through an open belt drive. The speed of the motor is 1500 rpm and the line shaft should rotate at 600rpm. The maximum linear speed at which the belt should run is 1200 m/min. Determine the diameters of the pulleys when

i) Thickness of belt is neglected
ii) Thickness of belt is 12mm
iii) 5% total slip is taken by considering thickness of belt. **(10 Marks)**

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