



B.E. DEGREE EXAMINATIONS: APRIL / MAY 2023

(Regulation 2018)

Fourth Semester

MECHATRONICS ENGINEERING

U18MCT4104: Theory of Machines

COURSE OUTCOMES

- CO1:** Apply concepts of mechanisms to achieve desired motion transformation
- CO2:** Choose appropriate gear train and friction drives for a given application
- CO3:** Calculate various forces acting on rigid bodies under static and dynamic conditions
- CO4:** Solve balancing problems related to rotating and reciprocating masses
- CO5:** Apply the fundamental concepts of vibrating system to predict the natural frequency and force transmitted

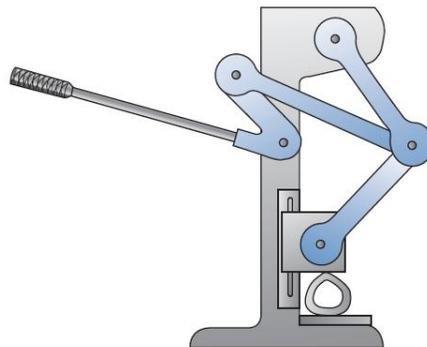
Time: Three Hours

Maximum Marks: 100

**Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)**

1. Determine number of DoF for given mechanism.

CO1 [K₃]



2. List the types of kinematic pair.

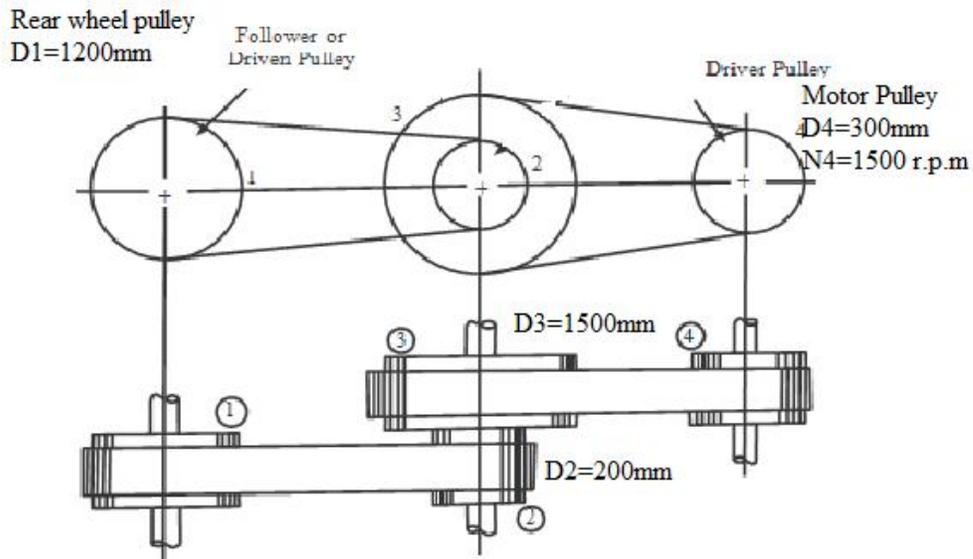
CO1 [K₂]

3. Draw compound and reverted gear train.

CO2 [K₂]

4. In an EV vehicle compound belt drive used to transmit motion from motor to rear wheel. In that motor runs at 1500rpm. Determine the speed of last driven which is connected with rear wheel.

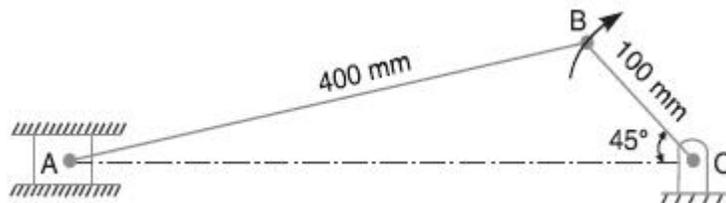
CO2 [K₃]



5. Define inertia force and inertia torque. . CO3 [K₂]
6. What is the significance of rigid body dynamics in machine design. CO3 [K₂]
7. Differentiate static and dynamic balancing. CO4 [K₃]
8. Why reciprocating masses are not fully balanced? CO4 [K₃]
9. Define the term transmissibility. CO5 [K₂]
10. Write the formula used to find circular natural frequency. CO5 [K₂]

**Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)**

11. a) Discuss the types of cam and follower with neat sketch. 12 CO1 [K₂]
 b) When the kinematic chain becomes a mechanism and write the purpose of 04 CO1 [K₂]
 mechanism.
12. The lengths of crank OB and connecting rod AB are 100 mm and 400 mm 16 CO1 [K₃]
 respectively. If the crank rotates clockwise with an angular velocity of 350 r.p.m,
 find: 1. Velocity of the slider A, and 2. Angular velocity of the connecting rod
 AB.



13. a) Two mating gears have 20 and 40 involute teeth of module 10 mm and 20° pressure angle. The addendum on each wheel is 6mm. Determine length of the path of contact, arc of contact and contact ratio. 10 CO2 [K₃]
- b) Calculate the power transmitted by cross belt drive connecting two pulley of 450 mm and 200 mm diameter, which are 1.95m apart. The maximum permissible tension in the belt is 1000 N, coefficient of friction is 0.20 and speed of larger pulley is 100 rpm and take angle of contact as 199° . 06 CO2 [K₃]
14. During a trial on steam engine, it is found that the acceleration of the piston is 36 m/s^2 when the crank has moved 30° from the inner dead centre position. The net effective steam pressure on the piston is 0.5 N/mm^2 and the frictional resistance is equivalent to a force of 600 N. The diameter of the piston is 300 mm and the mass of the reciprocating parts is 180 kg. If the length of the crank is 300 mm and the ratio of the connecting rod length to the crank length is 4.5, find:
1. Reaction on the guide bars, 2. Thrust on the crank shaft bearings, and 3. Turning moment on the crank shaft. 16 CO3 [K₃]
15. A shaft carries four masses A, B, C and D of magnitude 250 kg, 300 kg, 350 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 350 mm, 450 mm and 750 mm. The angles between the cranks measured anticlockwise are A to B 45° , B to C 80° and C to D 110° . The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions. 16 CO4 [K₃]
16. a) Discuss the types of vibration with neat sketch. 06 CO5 [K₂]
- b) A single cylinder vertical petrol engine of total mass 300 kg is mounted upon a steel chassis frame and causes a vertical static deflection of 2 mm. The reciprocating parts of the engine has a mass of 20 kg and move through a vertical stroke of 150 mm with simple harmonic motion. A dashpot is provided whose damping resistance is directly proportional to the velocity and amounts to 1.5 kN per metre per second.
Considering that the steady state of vibration is reached ; determine : 1. the amplitude of forced vibrations, when the driving shaft of the engine rotates at 480 r.p.m. 2. The speed of the driving shaft at which resonance will occur. 10 CO5 [K₃]
