Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 2016

SUBJECT: THEORY OF MACHINES [MTE 2201]

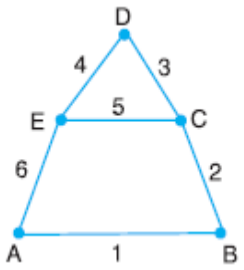
REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

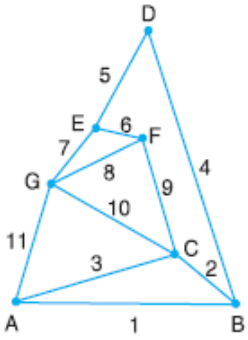
Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

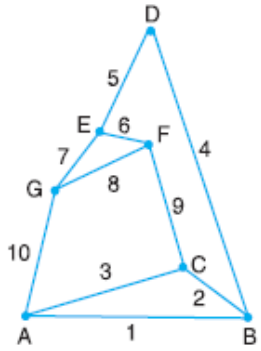
1A For the figures A, B, C and D of mechanisms shown below, determine whether it is a constrained chain or unconstrained chain or locked chain (rigid frame) by showing appropriate calculations. **4**



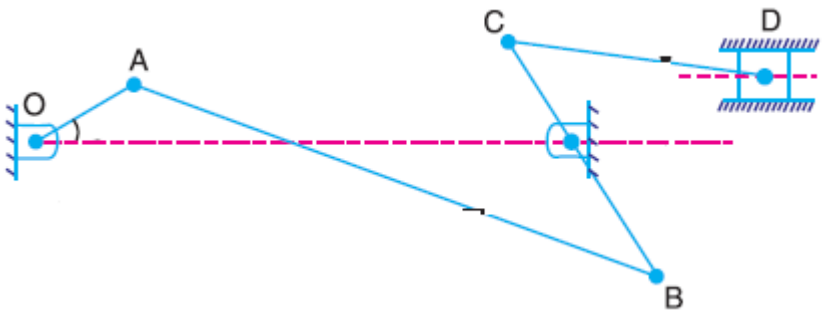
(A)



(B)



(C)

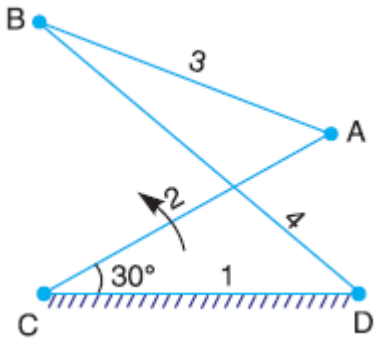


(D)

1B Why do slotted- lever mechanism is considered as quick return mechanism? Draw neat sketch in support of your answer and write the expression for quick return ratio. **3**

1C Enumerate the inversions of double slider crank chain with examples. **3**

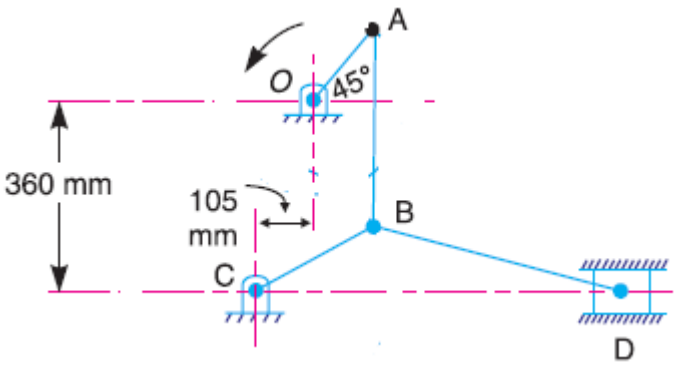
2A For the mechanism shown below, the dimensions of the links are CD = 65mm, CA = 60mm, DB = 80mm, AB = 55mm. Find angular velocities of link AB and DB, if crank CA rotates at 100 rpm in the anticlockwise direction. **3**



2B In the mechanism shown below, slider is constrained to move on horizontal path. The crank OA is rotating in the counter clockwise direction at a speed of 180 rpm increasing at the rate of 50 rad/s^2. The dimensions of the various links are as follows: **4**

OA = 180mm; CB = 240mm; AB = 360mm; and BD = 540mm.

Velocity of BA = 0.9m/s; BC = 2.8m/s; BD = 2.4m/s and slider D = 2.05m/s. Find the acceleration of slider and angular acceleration of link BD.



2C A shaft has a number of a collars integral with it. The external diameter of the collars is 400mm and the shaft diameter is 250 mm. If the intensity of pressure is 0.35 N/mm^2 (uniform) and the coefficient of friction is 0.05, estimate: a). Power absorbed when the shaft runs at 105 rpm carrying a load of 150 kN and b). Number of collars required. **3**

3A Derive an expression to determine the power transmitted due to friction in a single plate clutch using uniform wear theory. **3**

3B Discuss briefly with the sketches the longitudinal, transverse and torsional free vibrations. **2**

3C A cam rotating clockwise at uniform speed of 320 rpm operates a reciprocating knife edge follower. The follower motion is defined as below. **5**

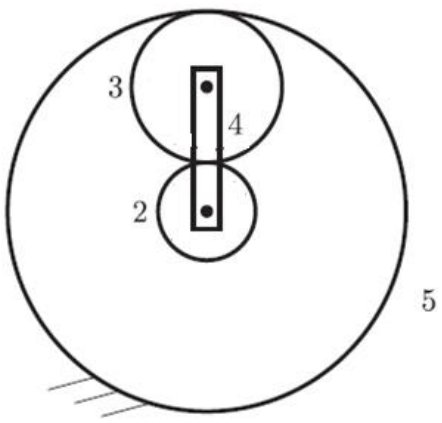
i. Outward during 90^0 with Uniform Acceleration and Retardation Motion
ii. Dwell for next 30^0
iii. Return during next 60^0 with Simple Harmonic Motion
iv. Dwell for the remaining period

Stroke of the follower is 40 mm. Minimum radius of the cam is 50 mm. Draw the cam profile when the line of stroke of the follower is offset by 15 mm.

4A A rotating shaft carried four masses A, B, C and D which are readily attached to it. The masses are 30 mm, 38 mm, 40 mm and 35 mm respectively from the axis of rotation. The masses A, C and D are 7.5 kg, 5 kg and 4 kg respectively. The axial distances between the planes of rotation of A and B is 600 mm and between B and C is 500 mm. The masses A and C are at right angle to each other, find for a complete dynamic balance. **5**

I) The angles between the masses B and D from mass A.
II) The axial distance between the planes of rotation of C and D
III) The magnitude of mass B

4B An epicyclic gear train in shown schematically in the given figure. The run gear 2 on the input shaft is a 20 teeth external gear. The planet gear 3 is a 40 teeth external gear. The ring gear 5 is a 100 teeth internal gear. The ring gear 5 is fixed and the gear 2 is rotating at 60 rpm CCW (CCW=counter-clockwise and CW=clockwise). What will be the speed of arm 4 attached to the output shaft? **2**



4C Derive an expression for minimum no. of teeth necessary for a gear to avoid interference. **3**

5A The following are particulars of a pair of spur gears. Number of teeth on pinion = 19. Pressure angle = 20^{o}. Module = 6.5mm. Addendum = 1 module and Pitch circle diameter of gear is 305.50 mm. Determine: **4**

i) Number of pairs of teeth in contact

ii) Angle of action of gear

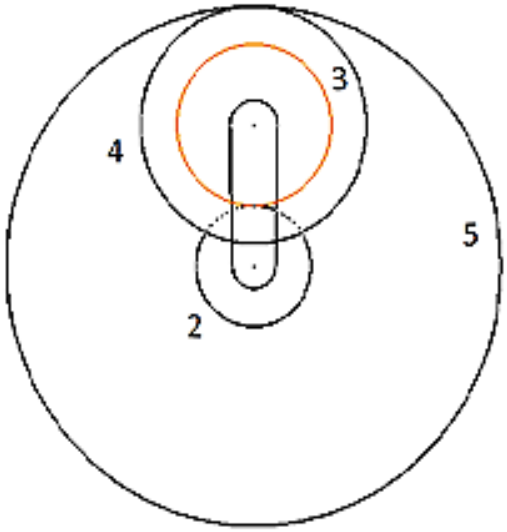
iii) Ratio of velocity of sliding to rolling velocity at the instant the engagement terminates.

5B For the epicyclic gear arrangement shown in the figure, wheel 5 is fixed and gear 3 and 4 are compound. If ω arm = 80 rad/s counter clockwise (CCW). **4**

i. Calculate the angular velocity gear 2 and gear 3 (in rad/s).

ii. Calculate the angular velocity of arm if ω2 = 20 rad/s clockwise and ω5 = 5 rad/s clockwise.

Given : T2 = 20; T3 = 24; T4 = 32; T5 = 80



5C A cam is to be designed for a Roller follower having cam lift of 40 mm for 90^{0} of cam rotation with SHM and dwell for next 30^{0}, during next 60^{0} of cam rotation follower returns to its original position with Uniform Acceleration and Deceleration motion and dwells for rest of the rotation. Determine the maximum velocity & acceleration during the outward & return stroke, if the cam rotates with 240 rpm. **2**