Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2019

SUBJECT: THEORY OF MACHINES [AAE3152]

REVISED CREDIT SYSTEM

(18/11/2019)

Duration: 3 Hours Max. Marks: 50

Instructions to Candidates:

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

1A) Differentiate between the following **(02)**

i) Higher pair and Lower pair
ii) Completely constrained and successfully constrained motion

1B) With a neat sketch, explain the construction and working of Elliptical trammel. Name the kinematic chain to which it belongs to. **(03)**

1C) A shaft carries four masses A, B, C & D of magnitudes 50 N, "B" N, 80 N and 40 N at radial distance of 4.8 mm, 6 mm, 9 mm and 7 mm respectively from the axis of rotation of the shaft. The planes of revolution of masses A and B are 200 mm apart, while the planes of B and C are 100 mm apart. Angle between the radii of the masses A and C is 55° as in the end view. Find the magnitude of mass B and the distance between the planes of revolution of masses C and D in order to ensure complete dynamic balance. **(05)**

2A) List the characteristics of a Governor. **(02)**

2B) The following data refers to two mating standard spur gears **(03)**

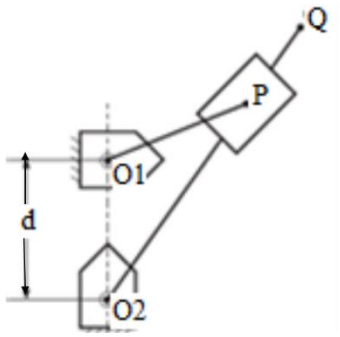
Gear ratio: 3, Module: 6 mm, Number of teeth on the pinion: 20, Pressure angle = 20^0.
Calculate the following,
i) The path of approach. ii) Angle of contact and iii) Number of pair of teeth in contact.

2C) The crank of a marine engine mechanism is 25 cms long and connecting rod is 100 cms long. At a given instant, the crank is turned through an angle of 210^0 clockwise from inner dead centre. Assuming the crank rotates at uniform speed of 180 rpm, find the velocity of the piston and angular velocity and angular acceleration of connecting rod. **(05)**

3A) With the help of a sketch, derive an expression for angle of heel of a motorcycle which is taking a turn about a circle of radius 'R' and experiences gyroscopic and centrifugal couple **(03)**

3B) Draw the profile of a cam operating a roller reciprocating follower having a lift of 40 mm. The roller diameter is 20 mm. The minimum radius of the cam is 30 mm. The cam raises the follower with SHM for 120° of its rotation followed by a period of dwell for 70°. The follower descends for the next 120° rotation of the cam with uniform acceleration and deceleration followed by a dwell period. If the cam rotates at a uniform speed of 120 rpm, calculate the maximum velocity and maximum acceleration of the follower during the ascent of the follower. **(07)**

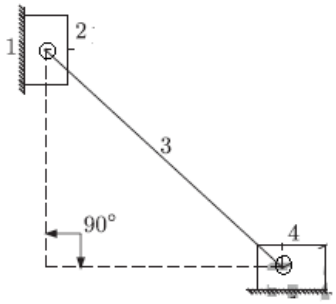
4A) A simple quick return mechanism is shown in the figure. The forward to return ratio of the quick return mechanism is 2:1. If the radius of crank *O*1*P* is 125 mm, then find the distance 'd '. **(02)**



4B) Two 20^0 involute spur gears have a module of 6mm. The larger wheel has 36 teeth and pinion has 16 teeth. If addendum equals to one module, does the interference occurs? What will be the effect if the number of teeth on pinion is reduced to 14? **(03)**

4C) In a sun and planet gear train, sun gear having 50 teeth and fixed to the frame. Find the number of teeth on planet gear and annulus gear if the arm rotates 100 times and annulus rotates 130 times, both in the same direction. **(05)**

5A) The figure below shows a planar mechanism with single degree of freedom. Locate the instant centre 24 for the given configuration. **(02)**



5B) A spring loaded governor of the Hartnell type has arms of equal lengths. The weight rotate in a circle of 13 cm diameter when the sleeve is in mid-position and the weight arms are vertical. The equilibrium speed for this position is 450 rpm, neglecting friction. The maximum sleeve movement is to be 2.5 cm and the maximum variation of speed, taking friction into account, is to be 5 % of the mid-position speed. The weight of the sleeve is 39 N and the friction may be considered equivalent to 29 N at the sleeve. The power of the governor must be sufficient to overcome the friction by a one per cent change of speed either way at mid-position. Determine, neglecting obliquity effect of arms: **(06)**

(a) Weight of each rotating mass.
(b) Spring stiffness in N/cm.
(c) Initial compression of spring

5C) Match the items in columns I and II **(02)**

Column I	Column II
P. Higher Kinematic Pair	1. Grubler's Equation
Q. Lower Kinematic Pair	2. Line contact
R. Quick Return Mechanism	3. Euler's Equation
S. Mobility of a Linkage	4. Planar
	5. Shaper
	6. Surface contact