MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS

V SEMESTER B.TECH. MECHATRONICS

END SEMESTER EXAMINATIONS, Dec 2021

SUBJECT: THEORY OF MACHINES [MTE 3154]

(28-12-2021)

Time: 3 Hours **MAX. MARKS: 50**

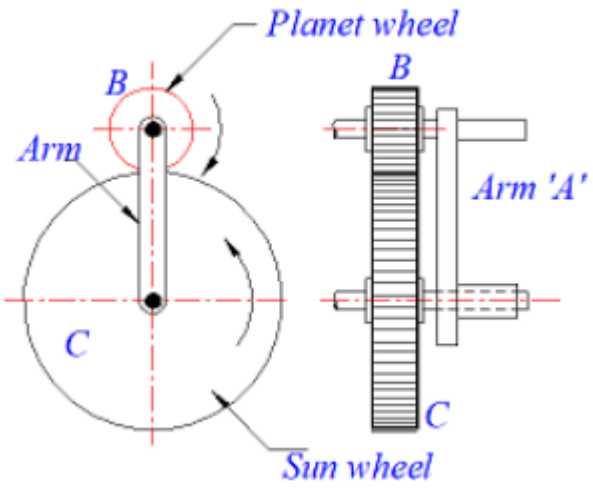
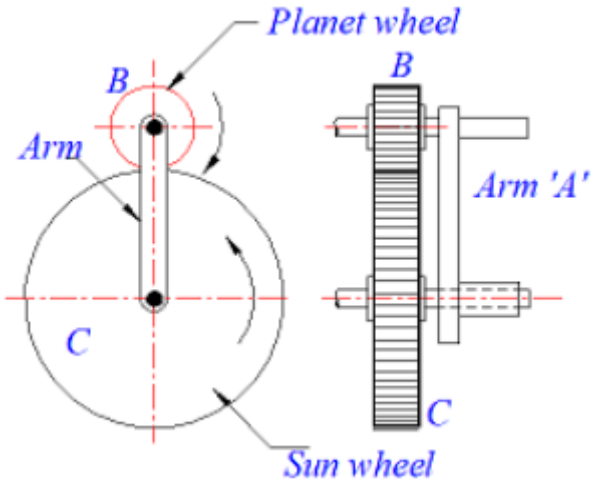
Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitable assumed.

Q. No	Part A	M	CO	PO	LO	BL
1	A ball and socket joint form a a) Turning pair; b) Rolling pair; c) Sliding pair; d)Spherical pair	1	1	1	1	1
2.	Ball bearing form a a) Turning pair; b) Rolling pair; c) Sliding pair; d)Spherical pair	1	1	1	1	1
3.	The motion of a shaft between a foot step bearing is an example of a) Incompletely constrained motion; b) Completely constrained motion; c)Successfully constrained motion; d) None of these	1	1	1	1	1
4.	In a kinematic chain with four lower pairs, if all the four lower pairs are turning pairs, the mechanism is classified into the chain known as a) Crossed slider crank chain; b) four bar chain; c) slider crank chain; d) double slider crank chain	1	1	1	1	2
5.	The Ackermann steering gear is the inversion of a a) Crossed slider crank chain; b) four bar chain; c) slider crank chain; d) double slider crank chain	1	1	1	1	2
6.	In a rigid link AB, ω is the angular velocity of the link AB about A, then normal component of acceleration of B relative to A will be equal to a) V^2_{BA}/AB; b) V_{BA} X AB; c) V^2_{BA} X AB; d) V_{BA}/AB b) Where V_{BA} = linear velocity of B relative to A	1	2	2	1	2
7.	The Coriolis component of acceleration exists only whenever a point a) Moves along a circular path; b) moves in a straight line; c) moves along a straight line which has rotational motion; d) moves in circular path which is also moving	1	2	1	1	1

8.	Two intersecting and co-planar shafts are connected by gears. This type of gear is called a) Helical gear; b) spur gear; c) bevel gear; d) herringbone gear	**1**	**4**	**1**	**1**	**1**
9.	The product of the circular pitch and diametral pitch is equal to a) π; b) $1/\pi$; c) $\pi/2$; d) 1	**1**	**4**	**2**	**2**	**2**
10.	The product of the module and diametral pitch is equal to a) π; b) 2π; c) $\pi/2$; d) 1	**1**	**4**	**2**	**2**	**2**
11.	The three precision points in the range $1<x<4$ are a) 1.1, 2.5, 3.9; b) 1.27, 2.5, 3.73; c) 1.36, 2.5, 3.64; d) 1.2, 2.5, 3.8	**1**	**5**	**2**	**2**	**3**
12.	The locus of a point on the circumference of a circle, which rolls without slipping on a fixed straight line is known as a) involute; b) cycloid; c) hypocycloid; d) epicycloid	**1**	**4**	**1**	**1**	**1**
13.	When the axes of the first and last wheels of a compound gear train are co-axial, then the train is known as a) epicyclic gear train; b) reverted gear train; c) coaxial gear train; d) hypocyclic gear train	**1**	**4**	**1**	**1**	**1**
14.	Which one is correct statement regarding flywheel? a) The flywheel reduces the fluctuation of speed during a cycle for constant output load b) The flywheel controls the mean speed of the prime mover c) The flywheel adjusts supply when output is varying d) The flywheel has no influence over cyclic speed fluctuation	**1**	**3**	**1**	**1**	**2**
15.	When the balance weights are introduced in a plane parallel to the plane of rotation of the disturbing weight, then the minimum number of balance weights for balancing a single revolving disturbing weight will be a) One; b) two; c) three; d) four	**1**	**3**	**1**	**1**	**2**
16.	The locus of a point on the circumference of a circle, which rolls without slipping on the outside of another circle is known as a) involute; b) cycloid; c) hypocycloid; d) epicycloid	**1**	**4**	**1**	**1**	**1**
17.	A gear train, in which at least one of the gear axes is in motion relative to the frame is known as a) epicyclic gear train; b) reverted gear train; c) coaxial gear train; d) hypocyclic gear train	**1**	**4**	**1**	**1**	**1**
18.	Number of links present in the Watt's straight line mechanism is a) 3; b) 4; c) 5; d) 6	**1**	**1**	**1**	**1**	**2**
19.	The ratio of the maximum fluctuation speed to the mean speed is called a) Fluctuation of energy; b) Coefficient of fluctuation of energy; c) coefficient of fluctuation of speed; d) energy stored in flywheel	**1**	**3**	**1**	**1**	**1**

20.	For two gear of equal size with 20^o pressure angle and addendum equal to one module, the minimum number of teeth on each gear to avoid interference is a) 12; b) 13; c)18; d) 16	**1**	**4**	**2**	**2**	**3**
21.	The coriolis component of acceleration is taken in account for a) Slider crank mechanism; b) Toggle mechanism; c) quick return motion mechanism; d) four bar mechanism	**1**	**2**	**1**	**1**	**2**
22.	The synthesis of mechanism deals with a) The determination of input and output angles of a mechanism b) The determination of dimensions of the links in mechanism c) The determination of displacement, velocity and acceleration of the links in a mechanism d) The determination of torque transmission capacity of the link	**1**	**4**	**1**	**1**	**2**
23.	Involute profile is preferred to cycloidal because a) The profile is easy to cut; b)only one curve is required to cut; c) the rack has straight line profile and can be cut accurately; d) it is stronger than cycloidal	**1**	**4**	**1**	**1**	**2**
24.	Two involute gears in mesh, initial contact occurs where the ---------- ---------- intersects the line of action. (Pinion is driver, Wheel is driven) a) Addendum circle of the wheel; b) Dedendum circle of the wheel; c) Dedendum circle of the pinion; d) Addendum circle of the pinion	**1**	**4**	**1**	**1**	**1**
25.	In involute gears, the points of contact lie on the line of action, which is the common tangent to the two a) Pitch circles; b)base circles; c) addendum circles; d) dedendum circles	**1**	**4**	**1**	**1**	**1**
26.	Two meshing involute gear of 32 teeth, each have a module of 5mm and pressure angle of 20o. If path of contact = 1.6 times the circular pitch find the contact ratio. a) 1.6; b) 1.7; c)1.5; d)2.1	**1**	**4**	**1**	**1**	**2**
27	A simple epicyclic gear has a fixed sun gear with 60 teeth and a planet gear with 30 teeth. If the arm is revolved once, how many times does the planet gear revolve? a) 1; b) 2; c) 3; d) 0.5	**1**	**4**	**1**	**1**	**2**

						
28	A simple epicyclic gear has a sun gear with 50 teeth and a planet gear with 20 teeth. If the arm is fixed and sun gear revolved twice, how many times does the planet gear revolve? a) 2; b)5; c) 5/2; d)2/5 	**1**	**4**	**1**	**1**	**2**
29	A shaft running in bearings carries masses 20, 30 and 40kg, in planes A, B and C with centre of gravity from the axis of the shaft 30mm, 20mm and 10mm, respectively. The distances of planes B and C from A are 1000mm and 2000mm to the right of A. The relative angular position of the centre of gravity of the unbalanced masses are such that they are in static equilibrium. Find the angle between A and B	**1**	**3**	**1**	**1**	**2**
30	A shaft running in bearings carries masses 20, 30 and 40kg, in planes A, B and C with centre of gravity from the axis of the shaft 30mm, 20mm and 10mm, respectively. The distances of planes B and C from A are 1000mm and 2000mm to the right of A. The relative angular position of the centre of gravity of the unbalanced masses are such that they are in static equilibrium. Find the angle between A and c	**1**	**3**	**1**	**1**	**2**
	Part B					
1a	Is it possible to build a mechanism with only three lower pairs? Justify your answer with a suitable sketch	**2**	**1**	**4**	**4**	**3**

1b	What are the defects occurs during synthesis, which can render a mechanism kinematically unsuitable for the design task	**3**	**5**	**2**	**2**	**3**
1c	In a four bar mechanism AB is fixed link, Crank AP is driving link of 36cm long, which is rotating anticlockwise at 75rpm and slowing down at the rate of 15 rad/s2. PQ is the coupler and BQ is the driven link. Find out the acceleration of P and Q and angular acceleration of link PQ and BQ, when crank makes 45o with the fixed link. PQ=105cm, BQ=75cm and AB=40cm, Velocity of PQ=4m/s, Velocity of BQ=4m/s	**5**	**2**	**3**	**3**	**4**
2a	In A modified four bar mechanism, Link 1&2, Link 2&3, Link 3 &4 form three turning pairs and Link 4&1 form sliding pair. A mechanism is built by fixing Link 3 (Referred as connecting rod in reciprocation engine). Explain its practical application with suitable sketch	**4**	**1**	**2**	**2**	**3**
2b	An epicyclic gear train consists of a sun wheel S, a stationery internal gear E, and three identical planet wheels P carried on a star shaped planet carrier C. The size of different toothed wheels are such that the planet carrier C rotates at 1/5 of the speed of the sun wheel S. The minimum number of teeth on any wheel is 16. Determine the number of teeth on different wheels of the train.	**4**	**4**	**3**	**3**	**4**
2c	Identify the mechanism used in stone crusher. With a sketch explain its unique characteristics	**2**	**1**	**1**	**1**	**3**