



Name: Roll No.:

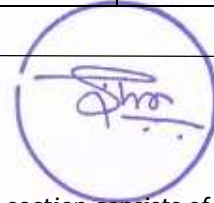
Branch: Signature of Invigilator:

Semester: IVth Date: 28/04/2022 (MORNING)

Subject with Code: ME207 KINEMATICS & DYNAMICS OF MACHINES

Marks Obtained	Section A (30)	Section B (20)	Total Marks (50)

INSTRUCTION TO CANDIDATE



1. The booklet (question paper cum answer sheet) consists of two sections. First section consists of MCQs of 30 marks. Candidates may mark the correct answer in the space provided / may also write answers in the answer sheet provided. The Second section of question paper consists of subjective questions of 20 marks. The candidates may write the answers for these questions in the answer sheets provided with the question booklet.
2. The booklet will be distributed to the candidates before 05 minutes of the examination. Candidates should write their roll no. in each page of the booklet.
3. Place the Student ID card, Registration Slip and No Dues Clearance (if applicable) on your desk. All the entries on the cover page must be filled at the specified space.
4. Carrying or using of mobile phone / any electronic gadgets (except regular scientific calculator)/chits are strictly prohibited inside the examination hall as it comes under the category of unfair means.
5. No candidate should be allowed to enter the examination hall later than 10 minutes after the commencement of examination. Candidates are not allowed to go out of the examination hall/room during the first 30 minutes and last 10 minutes of the examination.
6. Write on both side of the leaf and use pens with same ink.
7. The medium of examination is English. Answer book written in language other than English is liable to be rejected.
8. All attached sheets such as graph papers, drawing sheets etc. should be properly folded to the size of the answer book and tagged with the answer book by the candidate at least 05 minutes before the end of examination.
9. The door of examination hall will be closed 10 minutes before the end of examination. Do not leave the examination hall until the invigilators instruct you to do so.
10. Always maintain the highest level of integrity. Remember you are a BITian.
11. Candidates need to submit the question paper cum answer sheets before leaving the examination hall.

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: B. Tech
BRANCH: Mechanical

SEMESTER : IV
SESSION : SP/22

TIME: 2 Hours
SUBJECT: ME207 Kinematics and Dynamics of Machines

FULL MARKS: 50

Section - A

Q.1 Select the correct answers from the questions given below. [30 X 1]

- (i) A Kinematic chain having n links will have
(a) $(n - 1)$ unique inversions (b) (n) unique inversions (c) $(n + 1)$ inversions (d) None of these
- (ii) The motion of a piston in the cylinder of a steam engine is an example of
(a) completely constrained motion (b) incompletely constrained motion (c) successfully constrained motion (d) none of these
- (iii) A combination of kinematic pairs, joined in such a way that the relative motion between the links is completely constrained, is called a
(a) structure (b) mechanism (c) kinematic chain (d) inversion
- (iv) In a kinematic chain, a quaternary joint is equivalent to
(a) one binary joint (b) two binary joints (c) three binary joints (d) four binary joints
- (v) A kinematic chain is known as a mechanism when
(a) none of the links is fixed (b) one of the links is fixed (c) two of the links are fixed (d) all of the links are fixed
- (vi) The Grubler's criterion for determining the degrees of freedom (n) of a mechanism having plane motion is
(a) $n = (l - 1) - j$ (b) $n = 2(l - 1) - 2j$ (c) $n = 3(l - 1) - 2j$ (d) $n = 4(l - 1) - 3j$
where l = Number of links, and j = Number of pairs having one degree of freedom
- (vii) The mechanism forms a structure, when the number of degrees of freedom (n) is equal to
(a) 0 (b) 1 (c) 2 (d) - 1
- (viii) Which of the following is an inversion of single slider crank chain ?
(a) Beam engine (b) Watt's indicator mechanism (c) Elliptical trammels (d) Whitworth quick return motion mechanism
- (ix) The total number of instantaneous centres for a mechanism consisting of n links are
(a) $n/2$ (b) n (c) $(n - 1)/2$ (d) $n(n - 1)/2$
- (x) According to Aronhold Kennedy's theorem, if three bodies move relatively to each other, their instantaneous centres will lie on a
(a) straight line (b) parabolic curve (c) ellipse (d) none of these
- (xi) When a slider moves on a fixed link having curved surface, their instantaneous centre lies
(a) on their point of contact (b) at the centre of curvature (c) at the centre of circle (d) at the pin joint
- (xii) The direction of linear velocity of any point on a link with respect to another point on the same link is
(a) parallel to the link joining the points (b) perpendicular to the link joining the points (c) at 45° to the link joining the points (d) none of these
- (xiii) The two links OA and OB are connected by a pin joint at O. If the link OA turns with angular velocity ω_1 rad/s in the clockwise direction and the link OB turns with angular velocity ω_2 rad/s in the anti-clockwise direction, then the rubbing velocity at the pin joint O is
(a) $\omega_1 \cdot \omega_2 \cdot r$ (b) $(\omega_1 - \omega_2) r$ (c) $(\omega_1 + \omega_2) r$ (d) $(\omega_1 - \omega_2) 2 r$
where r = Radius of the pin at O.

- (xiv) A point B on a rigid link AB moves with respect to A with angular velocity ω rad/s. The total acceleration of B with respect to A will be equal to
 (a) vector sum of radial component and coriolis component
 (b) vector sum of tangential component and coriolis component
 (c) vector sum of radial component and tangential component
 (d) vector difference of radial component and tangential component
- (xv) The coriolis component of acceleration is taken into account for
 (a) slider crank mechanism (b) four bar chain mechanism (c) quick return motion mechanism (d) none of these
- (xvi) The maximum fluctuation of energy is the
 (a) sum of maximum and minimum energies (b) difference between the maximum and minimum energies (c) ratio of the maximum energy and minimum energy (d) ratio of the mean resisting torque to the work done per cycle
- (xvii) The ratio of the maximum fluctuation of speed to the mean speed is called
 (a) fluctuation of speed (b) maximum fluctuation of speed (c) coefficient of fluctuation of speed (d) none of these
- (xviii) When the sleeve of a Porter governor moves upwards, the governor speed
 (a) increases (b) decreases (c) remains unaffected (d) none of these
- (xix) A Hartnell governor is a
 (a) pendulum type governor (b) spring loaded governor (c) dead weight governor (d) inertia governor
- (xx) A disturbing mass m_1 attached to a rotating shaft may be balanced by a single mass m_2 attached in the same plane of rotation as that of m_1 such that
 (a) $m_1 \cdot r_2 = m_2 \cdot r_1$ (b) $m_1 \cdot r_1 = m_2 \cdot r_2$ (c) $m_1 \cdot m_2 = r_1 \cdot r_2$
 where r_1 and r_2 are the radius of rotation of mass m_1 and m_2 , respectively.
- (xxi) In order to have a complete balance of the several revolving masses in different planes
 (a) the resultant force must be zero (b) the resultant couple must be zero (c) both the resultant force and couple must be zero (d) none of the above
- (xxii) The primary unbalanced force is maximum when the angle of inclination of the crank with the line of stroke is
 (a) 0° (b) 90° (c) 180° (d) 360°
- (xxiii) When the primary direct crank of a reciprocating engine makes an angle θ with the line of stroke, then the secondary direct crank will make an angle of with the line of stroke.
 (a) $\theta / 2$ (b) θ (c) 2θ (d) 4θ
- (xxiv) The secondary unbalanced force produced by the reciprocating parts of a certain cylinder of a given engine with crank radius r and connecting rod length l can be considered as equal to primary unbalanced force produced by the same weight having
 (a) an equivalent crank radius $r^2/4l$ and rotating at twice the speed of the engine
 (b) $r^2/4l$ as equivalent crank radius and rotating at engine speed
 (c) equivalent crank length of $r^2/4l$ and rotating at engine speed
 (d) none of the above
- (xxv) In a simple gear train, if the number of idle gears is odd, then the motion of driven gear will
 (a) be same as that of driving gear (b) be opposite as that of driving gear (c) depend upon the number of teeth on the driving gear (d) none of the above
- (xxvi) The train value of a gear train is
 (a) equal to velocity ratio of a gear train (b) reciprocal of velocity ratio of a gear train
 (c) always greater than unity (d) always less than unity
- (xxvii) When the axes of first and last gear are co-axial, then gear train is known as
 (a) simple gear train (b) compound gear train (c) reverted gear train (d) epicyclic gear train
- (xxviii) In a gear train, when the axes of the shafts, over which the gears are mounted, move

relative to a fixed axis, is called

(a) simple gear train (b) compound gear train (c) reverted gear train (d) epicyclic gear train

(xxix) The angle between the direction of the follower motion and a normal to the pitch curve is called

(a) pitch angle (b) prime angle (c) base angle (d) pressure angle

(xxx) A disc spinning on its axis at 20 rad/s will undergo precession when a torque 100 N-m is applied about an axis normal to it at an angular speed, if mass moment of inertia of the disc is the 1 kg-m²

(a) 2 rad/s (b) 5 rad/s (c) 10 rad/s (d) 20 rad/s

Section - B

Q. 2 Attempt any four questions

[4 X 5]

(i) For the position of the mechanism shown in Figure 1, calculate the angular velocity of the link AR. OA is 300 mm long and rotates at 20 rad/s in the clockwise direction. OQ = 650 mm and the link AR is making sliding pair with the oscillating lever mounted at the fixed point Q, so that B and Q are two coincident point and B is on the link AR.

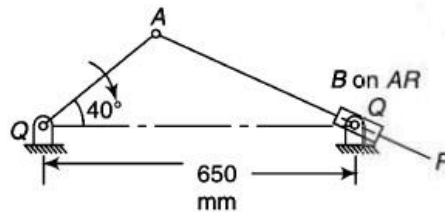


Figure 1

(ii) A horizontal gas engine running at 210 rpm has a bore of 220 mm and a stroke of 440 mm. The connecting rod is 924 mm long and the reciprocating parts weigh 20 kg. When the crank has turned through an angle of 30° from the inner dead centre, the gas pressures on the cover and crank sides are 500 kN/m² and 60 kN/m², respectively. Diameter of the piston rod is 40 mm. Determine the turning moment on the crank shaft.

(iii) Describe the working principle of a centrifugal governor with a neat sketch.

(iv) Three masses of 8 kg, 12 kg, and 15 kg attached at radial distances of 80 mm, 100 mm, and 60 mm, respectively to a disc on a shaft are in complete balance. Determine the angular positions of the masses of 12 kg and 15 kg relative to the 8 kg mass. Assume the angular position of the 8 kg mass at 0°.

(v) An epicyclic gear train consists of an arm and two gears A and B having 30 and 40 teeth, respectively as shown in Figure 2. The arm rotates at a speed of 80 rpm counter-clockwise. Determine the speed of the gear B if (i) the gear A is fixed, and (ii) the gear A revolves at 240 rpm clockwise instead of being fixed.

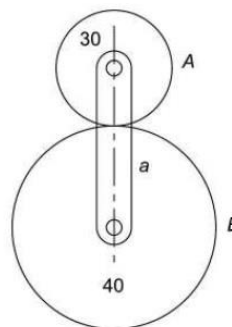


Figure 2



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