

# VTU B.E/B.TECH QUESTION PAPER SET

## CBCS SEMESTER IV

# MECHANISMS AND MACHINE THEORY

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# CBCS Scheme

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15AE44

## Fourth Semester B.E. Degree Examination, June/July 2017 Mechanisms and Machine Theory

Time: 3 hrs.

Max. Marks: 80

Note: Answer FIVE full questions, choosing one full question from each module.

### Module-1

- Sketch and derive the length of stroke and ratio between time taken during the cutting and return stroke of a crank and slotted quick return motion mechanism. (08 Marks)
  - Determine the number of degrees of freedom for the simple mechanisms shown in the Fig.Q1(b)(i), (ii) and (iii). (08 Marks)

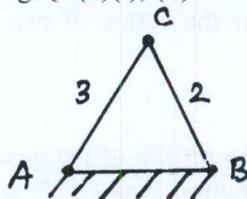


Fig.Q1(b)(i)

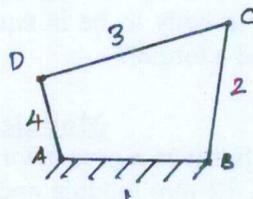


Fig.Q1(b)(ii)

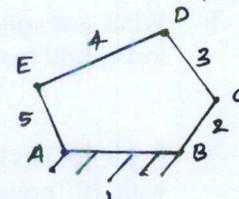


Fig.Q1(b)(iii)

OR

- Sketch and explain the inversions of four bar mechanism. (08 Marks)
  - Fig.Q2(b) shows the layout of a quick return mechanism of the oscillating link type, for a special purpose machine. The driving crank BC is 30 mm long and time ratio of the working stroke to the return stroke is to be 1.7. If the length of the working stroke of R is 120 mm, determine the dimensions of AC and AP.

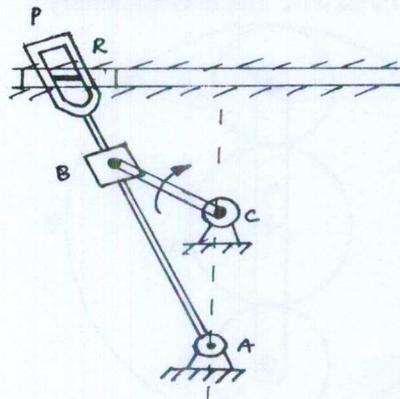


Fig.Q2(b)

(08 Marks)

### Module-2

- An engine mechanism is shown in Fig.Q3. The crank  $CB = 100$  mm and the connecting rod  $BA = 300$  mm. With centre of gravity G, 100 mm from B. In the position shown, the crankshaft has a speed of  $75$  rad/s and an angular acceleration of  $1200$  rad/s<sup>2</sup>. Find velocity of G and angular velocity of AB, and acceleration of G and angular acceleration of AB.

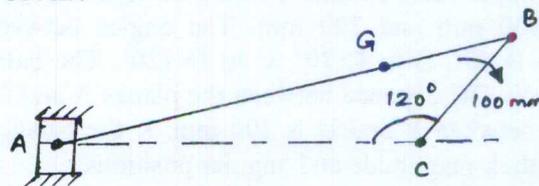


Fig.Q3

(16 Marks)

1 of 3

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42-8-50, will be treated as malpractice.

OR

- 4 a. A four-link mechanism with the following dimensions is acted upon by a force 80 N with an inclination of  $150^\circ$  on the link DC.  $AD = 500$  mm,  $AB = 400$  mm,  $BC = 1000$  mm,  $DC = 750$  mm,  $DE = 350$  mm. Determine the input torque  $T$  on the link AB for the static equilibrium of the mechanism for the given configuration. [Refer Fig.Q4(a)]

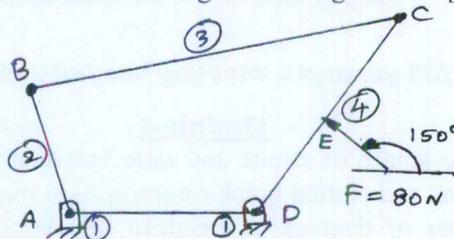


Fig.Q4(a)

(12 Marks)

- b. What are conditions for a body to be in equilibrium under the action of two forces, three forces and two forces and a torque? (04 Marks)

Module-3

- 5 a. A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with  $20^\circ$  pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio. (10 Marks)
- b. Write short notes on undercutting in gears. (06 Marks)

OR

- 6 a. An epicyclic gear train is shown in Fig.Q6(a). The number of teeth on A and B are 80 and 200. Determine the speed of the arm a :  
 i) If A rotates at 100 rpm clockwise and B at 50 rpm counter clockwise.  
 ii) If A rotates at 100 rpm clockwise and B is stationary.

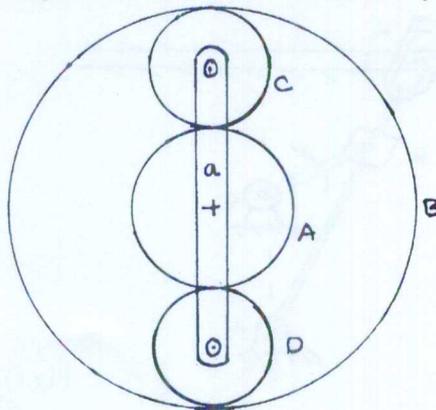


Fig.Q6(a)

(12 Marks)

- b. Briefly explain the types of gear trains. (04 Marks)

Module-4

- 7 A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B  $45^\circ$ , B to C  $70^\circ$ , C to D  $120^\circ$ . 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 magnitude and angular positions. (16 Marks)

OR

- 8 A five cylinder in-line engine running at 750 rpm has successive cranks  $144^\circ$  apart, the distance between the cylinder centre lines being 375 mm. The piston stroke is 225 mm and the ratio of the connecting rod to the crank is 4. Examine the engine for balance of primary and secondary forces and couples. Find the maximum values of these and the positions of the central crank at which these maximum values occur. The reciprocating mass of each cylinder is 15 kg. (16 Marks)

**Module-5**

- 9 a. In an open-arm type governor shown in Fig.Q9(a).  $AE = 400$  mm,  $EF = 50$  mm and angle,  $\theta = 35^\circ$ . Determine the percentage of change in speed when  $\theta$  decrease to  $30^\circ$ .

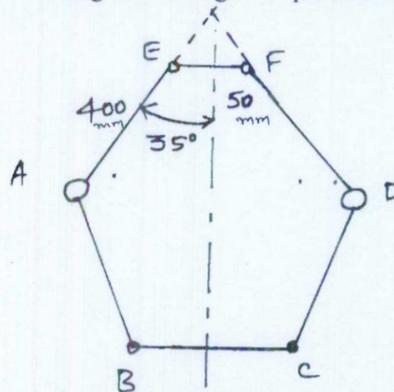


Fig.Q9(a)

(08 Marks)

- b. Each arm of a porter governor is 200 mm long and is pivoted on the axis of the governor. The radii of rotation of the balls at the minimum and the maximum speeds are 120 mm and 160 mm respectively. The mass of the sleeve is 24 kg and each ball is 4 kg. Find the range of speed of the governor. Also determine the range of speed if the friction at the sleeve is 18 N.

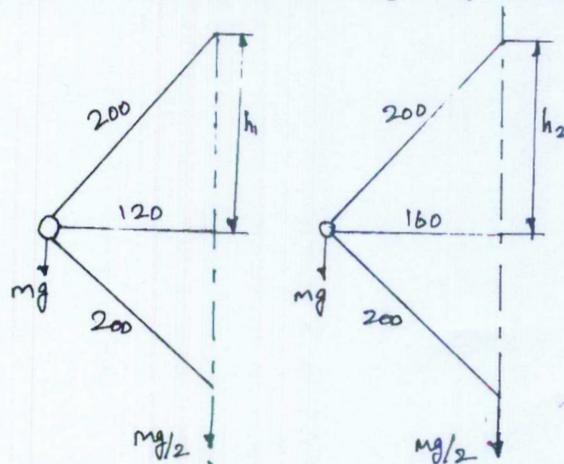


Fig.Q9(b)

(08 Marks)

OR

- 10 Explain in detail about the effect of gyroscopic couple on a Naval ship during:  
 i) Steering  
 ii) Pitching and  
 iii) Rolling. (16 Marks)

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# CBCS Scheme

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## Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018 Mechanisms and Machine Theory

Time: 3 hrs.

Max. Marks: 80

**Note: Answer any FIVE full questions, choosing one full question from each module.**

### Module-1

- 1 a. Define : i) Lower pair    ii) Higher pair    iii) Kinematic chain  
    iv) Mechanism    v) Machine    vi) Degree of freedom. (06 Marks)  
 b. Determine DOF of link

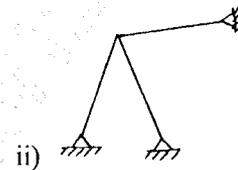
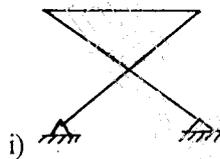


Fig.Q1(b)

(10 Marks)

OR

- 2 a. Prove the Peaucellier's mechanism traces exact straight line motion. (08 Marks)  
 b. Obtain condition for 'correct steering' for a four wheeled vehicle. (08 Marks)

### Module-2

- 3 a. Describe Angular velocity and relative velocity. (04 Marks)  
 b. For a four bar mechanism shown in Fig. Q3(b), determine the acceleration of a C and angular acceleration of link 3 when crank 2 rotates at 20 radians per second.

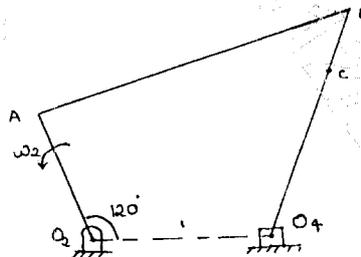


Fig. Q3(b)

(12 Marks)

OR

- 4 In a crank and slotted lever mech quick return mechanism, the fixed centre 'O' and 'C' are at distance 200mm. The length of driving crank cp is 100mm and it rotates at 60, the length of the link 'ON' is 400mm and the length of the link NR is 160mm. The line of stroke of ram 'R' is horizontal and 200mm above the fixed center C. At the instant when the angle OCP is 120°. Find the velocity and acceleration of ram R. (16 Marks)

### Module-3

- 5 a. State and prove law of gearing or condition for correct gearing. (06 Marks)  
 b. Two gear wheels of module pitch 4.5mm have 24 and 33 teeth respectively. Pressure angle = 20°. Each wheel has a standard addendum of one module. Find :  
     i) length of arc of contact and  
     ii) Maximum velocity of sliding if the speed of smaller wheel is 120 rpm. (10 Marks)

OR

- 6 a. Explain with neat sketches :  
 i) Compound gear train    ii) Epicyclic train. (06 Marks)  
 b. An internal wheel B with 80 teeth is keyed to a shaft F. A fixed internal wheel 'C' with 80 teeth is concentric with B. A compound wheel D-E gears with the two internal wheels, D has 28 teeth and gears with C while E gears with B. The compound wheels revolve freely on a pin which projects from a disc keyed to a shaft A co-axial with F. If all the wheels have the same pitch and shaft A makes 800 rpm, what is the speed of shaft F. (10 Marks)

**Module-4**

- 7 a. Explain balancing of rotating masses, where both the masses are on the same side. (06 Marks)  
 b. A shaft carries four masses  $M_1$ ,  $M_2$ ,  $M_3$  and  $M_4$  attached to it. They all revolve in the same plane the magnitude of the masses are 6, 5, 9 and 7.5 kg respectively. The C.G of the masses are located at a radial distance of 100, 125, 150 and 75mm from the axis of the shaft. The angular positions of the masses are  $60^\circ$ ,  $135^\circ$  and  $270^\circ$  from  $M_1$ . Determine the position and magnitude of mass  $M_5$  and 250mm radius to balance the system. (10 Marks)

OR

- 8 a. State the conditions of balance in a multi-cylinder in line engine. (06 Marks)  
 b. The following data are referred to a single cylinder engine speed = 250 rpm, stroke = 350mm. Mass of reciprocating parts = 60kg ; Mass of revolving parts at 175mm radius is 40kg. If  $\frac{2}{3}$ rd of reciprocating parts and all the revolving parts are to be balanced find.  
 i) Balancing mass required at 400mm radius  
 ii) Residual unbalanced force when the crank has rotated,  $60^\circ$  from T.D.C [Top dead centre or inner dead centre (IDC)]. (10 Marks)

**Module-5**

- 9 a. With a neat sketch, explain the working principle of a simple centrifugal governor. (06 Marks)  
 b. A porter governor has all four arms 300mm long, the upper arms are pivoted on the axis of rotation and lower arm arc attached to the sleeve at a distance 35mm from axis. The mass of each ball is 7kg and the load on the sleeve is 540N. Determine the equilibrium speed for the two extreme radii of 200mm and 260mm of rotation of governor balls. (10 Marks)

OR

- 10 a. Sketch and explain controlling force, curves of porter governor. (06 Marks)  
 b. The arms of a porter governor are each 300mm long and are hinged on the axis of rotation. The mass of each ball is 5kg. the radius of rotation of the ball is 200mm when the governor begins to lift and 250mm at the maximum speed. Determine the maximum and minimum speeds, if the mass of the sleeve is 15kg. Also find the range of speed if the frictional force at the sleeve is 30N. (10 Marks)

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# CBCS Scheme

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## Fourth Semester B.E. Degree Examination, June/July 2018 Mechanism and Machine Theory

Time: 3 hrs.

Max. Marks: 80

**Note: Answer any FIVE full questions, choosing one full question from each module.**

### Module-1

- 1 a. Describe the following : i) Kinematic link ii) Kinematic pair (08 Marks)  
b. Define mobility of mechanism and determine mobility of following mechanism. (08 Marks)

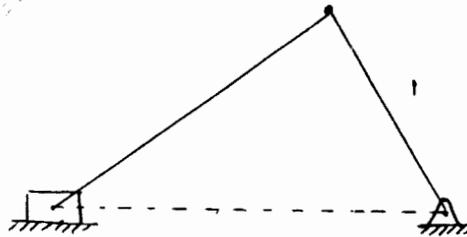


Fig Q1(b)

OR

- 2 a. Explain construction and working of peaucillier mechanism by means of a sketch. Prove that it generates an exact straight line. (08 Marks)  
b. Sketch and explain the working of Ackermann steering gear. (08 Marks)

### Module-2

- 3 In the mechanism shown in Fig Q3 crank rotates at 3000 rpm. Find the acceleration of the point 'C' in magnitude direction and sense. Find also the angular acceleration of link 3. (16 Marks)

$O_2A = 50\text{mm}$   
 $AB = 175\text{mm}$   
 $AC = 75\text{mm}$   
 $BC = 125\text{mm}$

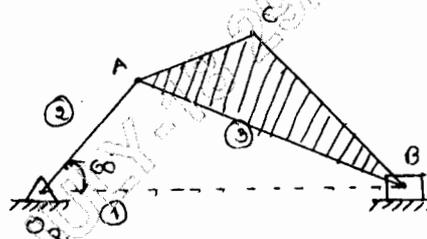


Fig Q3

OR

- 4 A four bar mechanism ABCD is made up of four links, pin pointed at the end. AD is a fixed link which is 180mm long. The links AB, BC and CD are 90mm, 120mm and 120mm long respectively. At certain instant, the link AB makes an angle of  $60^\circ$  with link 'AD' if the link 'AB' rotates at a uniform speed of 100rpm clockwise. Determine :  
i) Angular velocity of the link 'BC' and 'CD'  
ii) Angular acceleration of the link 'CD' and 'CB'. (16 Marks)

**Module-3**

- 5 a. Derive an expression for arc of contact for two meshing spur gears having involute profile. (08 Marks)
- b. Two spur gears have 30 teeth each of involute shape the circular pitch is 25mm. pressure angle =  $20^\circ$ . Determine the addendum of wheels if arc of contact is twice the circular pitch. (08 Marks)

OR

- 6 a. Explain with sketches: i) Reverted gear train ii) Epicyclic gear train. (08 Marks)
- b. An epicyclic gear train consists of a sunwheel 'S' a stationary 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. The minimum number of teeth on any wheel is 16. The driving torque on the sun wheel is 100Nm. Determine :
- Number of teeth on different wheels of train
  - Torque necessary to keep the internal gear stationary (08 Marks)

**Module-4**

- 7 a. Derive balancing of single revolving mass in two different planes. (08 Marks)
- b. A, B, C and D are 4 masses carried by a rotating shaft at radius 100, 125, 200 and 150mm respectively. The planes in which the masses revolve are spaced 600mm apart and the masses B, C and D are 10, 5, 4 kg respectively. Find the required mass 'A' and the relative angular position of the 4 masses to keep the shaft in balance. (08 Marks)

OR

- 8 a. Show that for a  $90^\circ$  v-engine the primary forces can be balanced by a single balancing mass. (08 Marks)
- b. In a 5 cylinder radial engine the cylinders are equally spaced. Mass of reciprocating parts per cylinder is 1 kg stroke length is 0.1m and length of C.R 0.15m. When the engine rotates at 3000 rpm find the maximum unbalanced primary and secondary forces. (08 Marks)
- Data  $\Rightarrow$  M = 1kg, Stroke = 0.1m, r = 0.05m,  $l = 0.15$ m, speed = 3000rpm.

**Module-5**

- 9 a. Derive an expression for the height of porter governor. (08 Marks)
- b. A porter governor has all the four arms of 300mm each. The upper arms as well as the sleeve arms are pivoted on the axis of rotation. The mass of each governor ball is 1kg. The mass of the sleeve is 20kg. Find the speed of rotation when the balls rotate at a radius of 15cms. If the friction forces between sleeve and spindle is 50N. Find the speed range during which governor is in sensitive at radius (of rotation of balls) = 15cms. If sleeve moves up by 3cm, what is the equilibrium speed? (08 Marks)

OR

- 10 a. Describe the effect of the gyroscopic couple on an aeroplane. (08 Marks)
- b. An aeroplane makes a complete half circle of 40m radius towards left when flying at 175 km/hr. The mass of the rotary engine and propeller is 400kg with radius of gyration 300mm. The engine runs at 2500 rpm clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft. What will be the effect if the aeroplane turns towards right instead of left? (08 Marks)

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**Fourth Semester B.E. Degree Examination, June/July 2019  
Mechanisms and Machine Theory**

Time: 3 hrs.

Max. Marks: 80

**Note: Answer any FIVE full questions, choosing ONE full question from each module.**

**Module-1**

1 a. Determine the degree of freedom of the mechanisms.

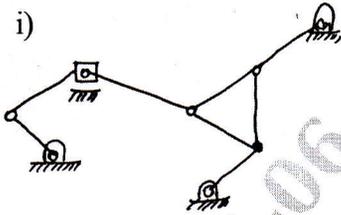


Fig Q1(a)(i)

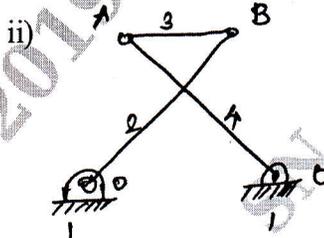


Fig Q1(a)(ii)

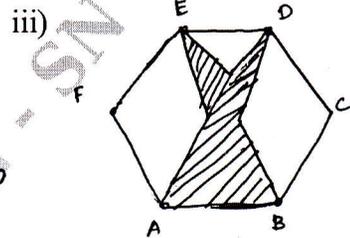


Fig Q1(a)(iii)

(08 Marks)

b. Differentiate between the following :

- i) Machine and Mechanism
- ii) Machine and Structure.

(08 Marks)

**OR**

- 2 a. Sketch and explain the any two inversions of four bar mechanism. (08 Marks)
- b. Explain the Ackerman steering wheel mechanism. (08 Marks)

**Module-2**

3 In a slider crank mechanism, the crank  $OB = 30\text{mm}$  and the connecting rod  $BC = 120\text{mm}$ . The crank rotates at a uniform speed of  $300\text{rpm}$  clockwise. For the crank position shown in Fig Q3. Find :

- i) Velocity of Piston C and angular velocity of connecting rod BC
- ii) Acceleration of Piston C and angular acceleration of connecting rod BC

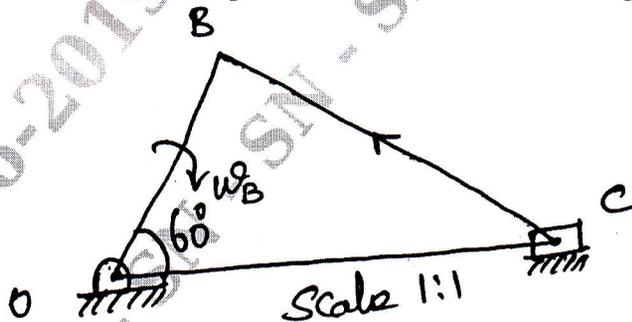


Fig Q3

(16 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

- 4 a. What are the conditions for a body to be in equilibrium under the action of two forces three forces and two forces and a torque? (06 Marks)
- b. An external force of 10N is acting horizontally on the rocker link, 30mm from the point D. Find the amount of torque to be applied to the crank AB to keep the mechanism in static equilibrium. (10 Marks)

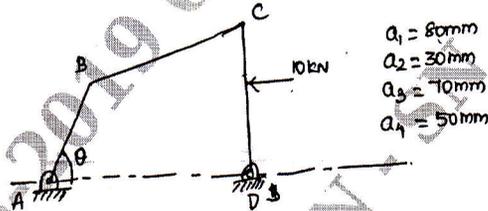


Fig Q4(b)

Module-3

- 5 a. Two equal spur gears of  $20^\circ$  involute teeth, module pitch 4mm and number of teeth 40 are in mesh. If the length of arc of contact is 1.75 times circular pitch. Find the addendum. (10 Marks)
- b. Define Interference and explain the methods to avoid interference. (06 Marks)

OR

- 6 a. Explain the types of gear trains. (04 Marks)
- b. An epicyclic gear train is shown in the figure 6(b). The number of teeth on A and B are 80 and 200. Determine the speed of the arm a :  
 i) If A rotates at 100rpm clockwise and B at 50 rpm counter clockwise.  
 ii) If A rotates at 100 rpm clockwise and B is stationary.

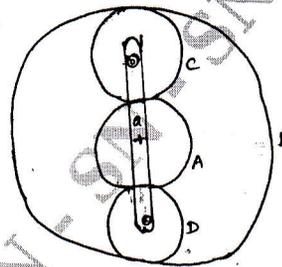


Fig Q6 (b)

(12 Marks)

Module-4

- 7 A shaft carries four masses A, B, C, D rotating at radii 100,125, 200 and 150mm respectively. The planes in which the masses revolve are spaced 600mm apart and the mass of B, C and D are 10kg,5kg and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. (16 Marks)

OR

- 8 A four crank engine has the two outer cranks set at  $120^\circ$  to each other, and their reciprocating masses are each 400kg. The distance between the planes of rotation of adjacent cranks between the planes of rotation of adjacent cranks are 450mm, 750mm and 600mm. If the engine is to be in complete primary balance, find the reciprocating mass and the relative angular position of the inner cranks. If the length of each crank is 300mm, the length of each connecting rod is 1.2m and the speed of rotation is 240 rpm. What is the maximum secondary unbalanced force? (16 Marks)

Module-5

- 9 A loaded governor of the porter-types has equal links 25cm long pivoted at the axis. The weight of each ball is 29.4N and the weight of the central load is 137.34N. The ball radius is 15cm when the governor begins to lift and 20cm at the maximum speed and the range of speed. If the friction at the sleeve is equivalent to 14.7N. Find the maximum and minimum speed and the range of speed. [Refer Fig.Q9] (16 Marks)

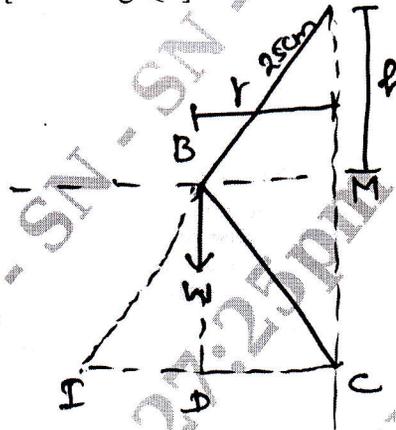


Fig Q9

OR

- 10 a. Explain in detail about the effect of gyroscopic couple in an aeroplane. (08 Marks)  
 b. An aircraft makes a half circle of 100m radius towards left when flying at 400km/hr. The engine and the propeller of the plane weighs 4.9kN having a radius of gyration of 50cm. The engine rotates at 3000 rpm. Clockwise when viewed from the rear. Find the gyroscopic couple and its effect on the aircraft. (08 Marks)

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15AE44

**Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020**  
**Mechanisms and Machine Theory**

Time: 3 hrs.

Max. Marks: 80

**Note: Answer any FIVE full questions, choosing ONE full question from each module.**

**Module-1**

- 1 a. Define Kinematic link, Kinematic chain, Kinematic pair with example. (06 Marks)  
 b. With neat diagram, explain different types of constrained motions. (04 Marks)  
 c. Differentiate between the following :  
 (i) Higher pair and Lower pair. (06 Marks)  
 (ii) Machine and Structure.

**OR**

- 2 a. Explain Whitworth quick return mechanism with neat diagram. (10 Marks)  
 b. Explain Pantograph mechanism with neat sketch and state its application. (06 Marks)

**Module-2**

- 3 For the mechanism shown in Fig. Q3 crank OA rotates at 20 rpm C.C.W, gives motion to sliding blocks B and D. OA = 300 mm, AB = 1200 mm, BC = 450 mm, CD = 450 mm. Determine (i) Velocity of B and D (ii) Angular velocity of CD (iii) Linear acceleration of D.

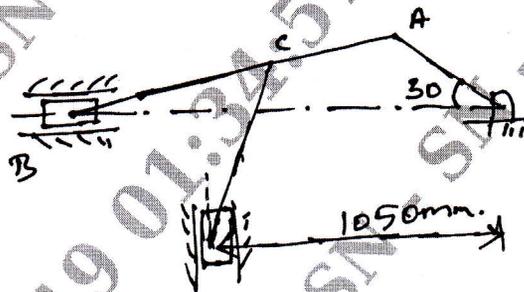


Fig. Q3

(16 Marks)

**OR**

- 4 A four bar mechanism under the action of 2 external forces as shown in Fig. Q4. Determine torque applied on AB for static equilibrium. AB = 50 mm, BC = 66 mm, CD = 55 mm, CE = 25 mm, CF = 30 mm,  $\angle BAD = 60^\circ$ , AD = 100 mm.

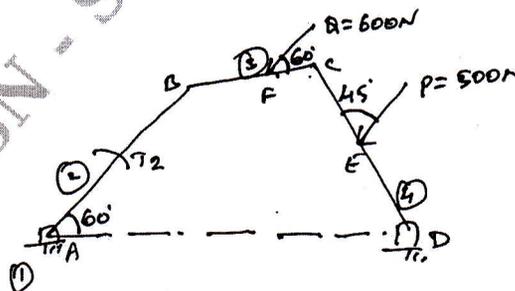


Fig. Q4

(16 Marks)

1 of 2

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

**Module-3**

- 5 a. Explain different types of gear trains with neat sketch. (04 Marks)  
 b. An epicyclic gear train consists of 3 gears 1, 2, 3 as shown in Fig. Q5 (b). Internal gear 1 has 32 teeth. Gear 2 meshes with both 1 and 3 and carried an Arm A which rotates about  $O_2$  at 20 rpm. If gear 1 is fixed find speed of 2 and 3.

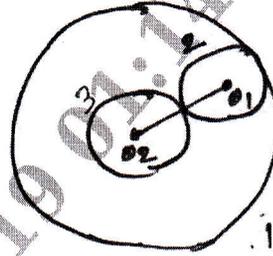


Fig. Q5 (b)

(12 Marks)

**OR**

- 6 a. Derive the expression for length of path of contact and length of arc of contact for a pair of involute gears in contact. (08 Marks)  
 b. A pinion having 30 teeth drives a gear having 80 teeth. The profile of gears is involute with  $20^\circ$  pressure angle 12 mm module and 10 mm addendum. Find the length of path of contact and length of arc of contact. (08 Marks)

**Module-4**

- 7 A 3.6 m long shaft carries 3 pulley's 2 at its ends and 3<sup>rd</sup> at the midpoint. The 2 end pulleys have masses 79 and 40 kg respectively, their C.G are 30 mm and 5 mm from the axis of shaft. The middle pulley has a mass of 50 kg and its C.G is 8 mm. The pulley are so keyed to shaft such that the assembly is statically balanced. The shaft rotates at 300 rpm in 2 bearings, 2 – 4 apart, with equal overhangs on either side. Determine  
 (i) Relative angular position of pulley.  
 (ii) Dynamic reaction on 2 bearings. (16 Marks)

**OR**

- 8 A piston of a 4 cylinder vertical incline engine each their uppermost position at  $90^\circ$  internal in order of their axial position. Pitch of cylinder = 0.35 m. Crank radius 0.12 m, length of C.R = 0.42 m. The engine runs at 600 rpm. If the reciprocating parts of each engine has mass of 2.5 kg. Find the unbalanced primary and secondary forces and couples. Take central plane of engine as reference. (16 Marks)

**Module-5**

- 9 In a porter governor all the arms are 15 cm long. Upper and lower arms are pivoted to links 2 cm and 3 cm respectively from the axis. Central mass is 40 kg mass of each ball is 4 kg. Force of friction is 30 N and the extreme radii of rotation are 8 cm and 10 cm. Determine the range of speed of governor. (16 Marks)

**OR**

- 10 Define Gyroscopic couple and explain gyroscopic effect on aeroplane for different turning conditions. (16 Marks)

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## CBCS SCHEME

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15AE44

**Fourth Semester B.E. Degree Examination, Aug./Sept.2020**  
**Mechanisms and Machine Theory**

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

- 1 With neat sketch explain  
 (i) Geneva Wheel Mechanism  
 (ii) Ratchet and Pawl Mechanism  
 (iii) Ackerman Steering Mechanism  
 (iv) Scotch Yoke Mechanism. (16 Marks)

OR

- 2 Sketch and explain  
 (i) Whitworth quick return mechanism  
 (ii) Crank and slotted lever mechanism (16 Marks)

Module-2

- 3 Fig.Q3 shows a four bar mechanism, crank  $O_2A$  rotates at 200 rpm and an angular acceleration of  $150 \text{ rad/sec}^2$  at the instant when the crank makes an angle of  $45^\circ$  to the horizontal. Find the acceleration of points B & C and angular velocities and angular acceleration of link 3 and 4.

$$\begin{aligned} O_2O_4 &= 120 \text{ mm} \\ O_2A &= 45 \text{ mm} \\ AB &= 90 \text{ mm} \\ O_4B &= 60 \text{ mm}, AC = 40 \text{ mm} \end{aligned}$$

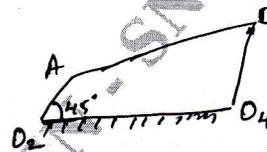


Fig.Q3

(16 Marks)

OR

- 4 Determine various forces and  $T_2$  for the mechanism shown in Fig.Q4.

$$\begin{aligned} AB &= 300 \text{ mm} \\ BC &= 600 \text{ mm} \\ BD &= 200 \text{ mm} \\ AE &= 200 \text{ mm} \end{aligned}$$

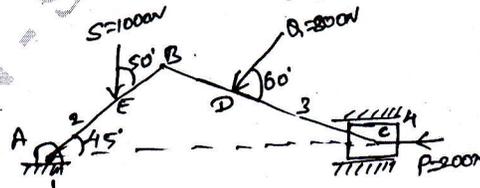


Fig.Q4

(16 Marks)

Module-3

- 5 a. Derive an expression for length of arc of contact for spur gear. (10 Marks)  
 b. Find the minimum number of teeth to avoid undercutting when the addendum for teeth is 0.84 module. Gear ratio is 3:1. Also find the length of arc of contact in terms of module. Pressure angle =  $20^\circ$ . (06 Marks)

OR

- 6 In an epicyclic gear train, the internal wheels A, B and the compound, wheel C and D rotate independently about the axis 'O'. The wheels E & F rotate on a pin fixed to the arm G. E gears with A & C, and F gears with B & D. Number of teeth on E & F are 18, C = 28, D = 26. Sketch the arrangement. Find number of teeth on A & B. If arm 'G' makes 150 rpm (CW) & A is fixed find  $N_B$ . If the arm 'G' makes, 50 rpm (CW) and  $N_A = 15$  rpm (CCW), Find  $N_B$ . (16 Marks)

Module-4

- 7 a. Explain the procedure for balancing several masses rotating in the same plane. (04 Marks)  
 b. A shaft carries four rotating masses A, B, C and D which are completely balanced. The masses B, C and D are 50kg, 80kg and 70 kg respectively. The masses C and D makes angles of  $90^\circ$  and  $195^\circ$  respectively with masses 'B' in same sense. The masses A, B, C and D are concentrated at radius 75mm, 100mm, 50mm and 90mm respectively. The plane of rotation of masses B and C are 250 mm apart. Determine mass A and its angular position, position of planes of A and D. (12 Marks)

OR

- 8 a. With usual notations, explain primary and secondary unbalanced forces of reciprocating masses. (04 Marks)  
 b. A 5 cylinder inline engine running at 500 rpm has successive cranks at  $144^\circ$  apart. The distance between the cylinder center line is 300 mm. Piston stroke = 240mm, length of CR = 480mm. Examine the engine for balance of primary and secondary forces and couples. Find the maximum value of these and position of central crank at which these maximum values occur. The reciprocating mass for each cylinder is 150 N. (12 Marks)

Module-5

- 9 a. Establish the relation between speed and height of porter Governor. (08 Marks)  
 b. The upper arms of porter governor are pivoted to axis of rotation. The length is 40cm. The lower arm pivoted on the sleeve at a distance of 2 cm from the axis, their length is 30cm. Mass of each ball is 5 kg the sleeve mass is 50 kg. Determine the equilibrium speed for the radius of rotation of 20 cm and also the effort and power of 1% speed change. (08 Marks)

OR

- 10 a. With usual notations and diagram, derive an expression for the gyroscopic couple produced by a rotating disc. (08 Marks)  
 b. With neat sketch explain gyroscopic effect on Aeroplane for all possibilities. (08 Marks)

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15AE44

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019

**Mechanisms and Machine Theory**

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing one full question from each module.***Module-1**

- 1 a. Define the following:
- i) Kinematic chain and pair      ii) Mechanism      iii) Structure
- iv) Inversions      v) Degree of freedom      (10 Marks)
- b. Explain any three inversions of double slider crank chain mechanisms.      (06 Marks)

**OR**

- 2 a. Explain the following mechanisms:
- i) Peaucellier's mechanism      ii) Geneva wheel mechanisms      (08 Marks)
- b. With a neat sketch, explain the condition for correct steering for Ackermann's mechanism.      (08 Marks)

**Module-2**

- 3 a. A four bar link mechanism is acted upon by forces as shown in Fig.Q3(a). Determine the torque  $T_2$  to be applied on link 2 to keep the mechanism in equilibrium. AD = 50 mm, AB = 40 mm, BC = 100 mm, DC = 75 mm, DE = 35 mm.

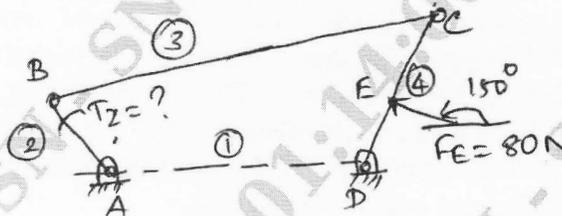


Fig.Q3(a)

- b. Describe angular velocity and relative velocity.      (12 Marks)
- (04 Marks)

**OR**

- 4 In a crank and slotter lever quick return mechanism, the fixed centre 'O' and 'C' are at a distance 200 mm. The length of driving crank CP is 100 mm and it rotates at 60, the length of the link 'ON' is 400 mm and the length of the link NR is 160 mm. The line of stroke of ram 'R' is horizontal and 200 mm above the fixed center C. At the instant when the angle OCP is 120°. Find the velocity and acceleration of ram R.      (16 Marks)

**Module-3**

- 5 a. Explain the Nomenclature of spur gear.      (10 Marks)
- b. Two 20° involute spur gears have a module of 10 mm. The addendum is equal to one module. The larger gear has 40 teeth while the pinion has 20 teeth. Will the gear interface with the pinion?      (06 Marks)

**OR**

- 6 a. With neat sketches explain the following:
- i) Compound gear train      ii) Epicyclic gear train      (04 Marks)

- b. The gearing of a machine tool is shown in Fig.Q6(b). The motor shaft is connected to gear A and rotates at 975 rpm. The gear wheels B, C, D and E are fixed to parallel shaft rotating together. The final gear F is fixed on the output shaft. What is the speed of gear F? The number of teeth on each gear are as given below:

| Gear         | A  | B  | C  | D  | E  | F  |
|--------------|----|----|----|----|----|----|
| No. of Teeth | 20 | 50 | 25 | 75 | 26 | 65 |

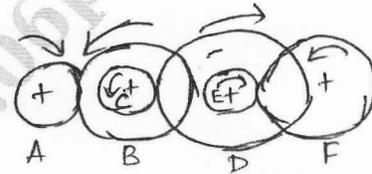


Fig.Q6(b) (06 Marks)

- c. In a epicyclic gear train, an arm carries two gear A and B, having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 rpm in the clockwise direction, what will be the speed of gear B?

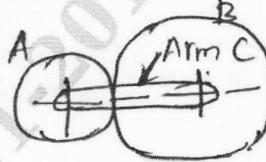


Fig.Q6(c) (06 Marks)

**Module-4**

7. A four cylinder vertical engine has cranks 150 mm long. The planes of rotation of the first, second and fourth cranks are 400 mm, 200 mm and 200 mm respectively from the third crank and their reciprocating masses are 50 kg, 60 kg and 50 kg respectively. Find the mass of the reciprocating parts for the third cylinder and the relative angular positions of the cranks in order that the engine may be in complete primary balance. (16 Marks)

**OR**

8. A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measures from 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70°, and C to D 120°. 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 Marks)

**Module-5**

9. a. Explain the types of governors. (04 Marks)  
 b. In a Hartnell governor, the length of ball and sleeve arms of a bell crank lever are 120 mm and 100 mm respectively. The distance of the fulcrum of the bell crank lever from the governor axis is 140 mm. Each governor ball has a mass of 4 kg. The governor runs at a mean speed of 300 rpm with the ball arms vertical and sleeve arms horizontal. For an increase of speed of 4%, the sleeve moves 10 mm upwards. Neglecting friction, find:  
 i) The minimum equilibrium speed if the total sleeve movement is limited to 20 mm.  
 ii) The spring stiffness  
 iii) The sensitiveness of the governor and  
 iv) The spring stiffness of the governor is to be isochronous at 300 rpm. (12 Marks)

**OR**

10. a. Describe the gyroscopic effect on airplane. (10 Marks)  
 b. An aeroplane flying at a speed of 300 kmph takes right turn with a radius of 50 m. The mass of engine and propeller is 500 kg and radius of gyration is 400 mm. If the engine runs at 1800 rpm in clockwise direction when viewed from tail end, determine the gyroscopic couple and state its effect on the aeroplane. What will be the effect if the aeroplane turns to its left instead of right? (06 Marks)

## CBCS SCHEME

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17AE/AS44

**Fourth Semester B.E. Degree Examination, June/July 2019**  
**Mechanism and Machine Theory**

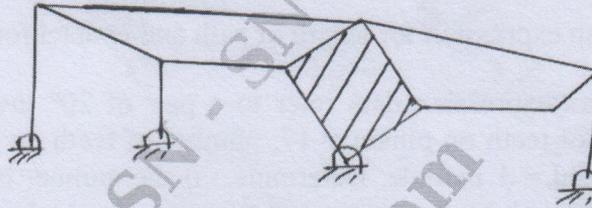
Time: 3 hrs.

Max. Marks: 100

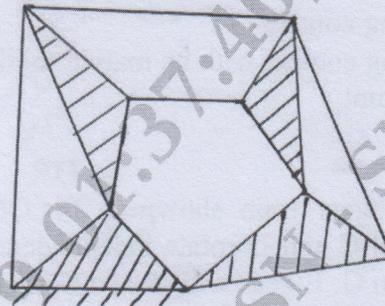
**Note: Answer any FIVE full questions, choosing  
ONE full question from each module.**

Module-1

- 1 a. Define : i) kinematic chain ii) machine iii) inversion iv) degree and freedom v) structure. (05 Marks)
- b. Determine the number of degree of freedom for the mechanisms shown in FigQ1(b)(i),(ii). (05 Marks)



FigQ1(b)(i)



FigQ1(b)(ii)

- c. Explain Whitworth quick return motion mechanism with a neat sketch. (10 Marks)

OR

- 2 a. Explain the working of an elliptical trammel. Prove that it traces an ellipse. (08 Marks)
- b. Explain crank and slotted lever mechanism with a neat sketch. (08 Marks)
- c. Discuss Ratchet and Pawl mechanism with a neat sketch. (04 Marks)

Module-2

- 3 A four bar mechanism ABCD is made up a four links, pin jointed at the ends. AD is a fixed link which is 180mm long. The links AB, BC and CD are 90mm, 120mm and 120mm long reactively. At certain instant, the link AB makes an angle a  $60^\circ$  (60 degrees) with the link AD. If the link AB rotates at a uniform speed of 100 rpm clockwise determine,
- i) Angular velocity A the links BC and CD.
- ii) Angular acceleration of the links CD and CB. (20 Marks)

OR

- 4 a. Determine the required input torque on the crank of a slider crank mechanism shown in Fig.Q4(a) for static equilibrium. (12 Marks)

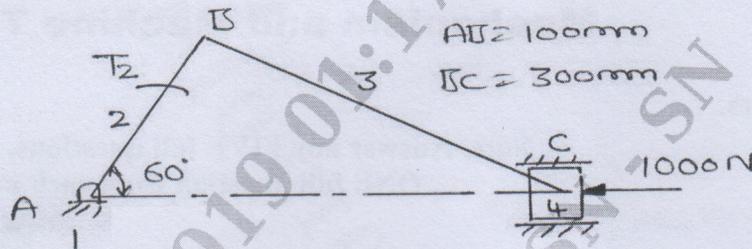


Fig.Q4(a)

- b. Explain the condition for the equilibrium of the following system i) Two force member ii) Three force member iii) Member with two force and a torque iv) Four force member. (08 Marks)

**Module-3**

- 5 a. Derive an expression for length of path and contact for a pair of involutes gear in contact. (10 Marks)
- b. Derive an expression data refer to a pair of  $20^\circ$  involutes gear in mesh module = 6mm, number of teeth on pinion = 17, number of teeth on gear = 49. Addendum on opinion and gear wheel = 1 module. Determine : i) the number of pair of teeth in contact ii) the angle turned through by the pinion and the gear wheel when one pair of teeth is in contact iii) the ratio of sliding to rolling motion when the tip of a tooth on the larger wheel.
- Is just making contact
  - Is just leaving contact with its mating tooth
  - Is at pitch point.
- (10 Marks)

OR

- 6 a. In an epicyclic gear train shown in Fig.Q6(a). The internal wheels A and B and the compound wheel C and D rotate independently about axis O. The wheel E and F rotate on pins fixed to arm G. E gear with A and C, and F gear with B and D. All the wheels have the same module and the number of teeth are  $T_C = 28$ ,  $T_D = 26$ ,  $T_E = T_F = 18$ .
- Find the number of teeth on A and B
  - If the arm G makes 100 rpm clockwise and A is fixed, find the speed of B.
  - If the arm G makes 100rpm clockwise and wheel A makes 10pm counter clockwise, find the speed of wheel B.

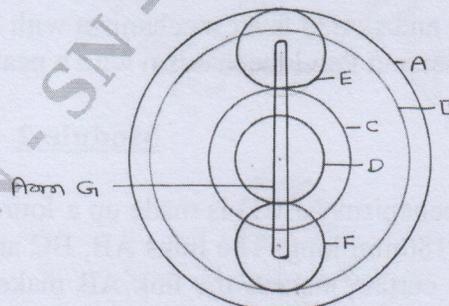


Fig.Q6(a)

- b. Explain compound gear train and reverted gear train with neat sketch. (06 Marks)

Module-4

- 7 a. A shaft carries four masses A, B, C and D of magnitude 200kg, 300kg, 400kg and 200kg respectively and revolving at radii 80mm, 70mm, 60mm and 80mm in planes measured from A at 300mm, 400mm and 700mm. The angle between the cranks measured anticlockwise are A to B  $45^\circ$ , B to C  $70^\circ$  and C to D  $120^\circ$ . The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100mm, between X and Y is 400mm and between Y and D is 200mm. If the balancing masses revolve at a radius of 100mm, Find their magnitude and angular positions. (16 Marks)
- b. Explain briefly static and dynamic balancing. (04 Marks)

## OR

- 8 a. The following data are referred to a single cylinder engine. Speed = 250rpm, stroke = 350mm. Mass of reciprocating part = 60kg, mass of revolving parts at 175mm radius is 40kg. If  $\frac{2}{3}$ <sup>rd</sup> of reciprocating parts and all the revolving parts are to be balanced find : i) balancing mass required a 400mm radius ii) residual unbalanced force when the crank has rotated  $60^\circ$  from top dead center. (08 Marks)
- b. In a four cylinder engine the two outer cranks are at  $120^\circ$  to each other and their reciprocating masses are each 100kg. The distance between the planes of rotation of adjacent crank are 450mm, 750mm and 450mm. Length of each crank is 300mm and the length of each connecting rod is 1200mm. Speed of engine is 240rpm. Find i) the reciprocating masses and relative angular position for each of the inner crank. (12 Marks)

Module-5

- 9 a. Derive an expression for the height and speed of porter governor. (10 Marks)
- b. The arm of a porter governor are 250mm long. The upper arm are pivoted on the axis of revolution, but the lower arms are attached to a sleeve at a distance of 50mm from the axis of rotation. The weight on the sleeve is 600N and the weight of each ball is 80N. Determine the equilibrium speed when the radius of rotation of the balls is 150mm. If the friction is equivalent to a load of 25N at the sleeve, determine the range of speed for this position. (10 Marks)

## OR

- 10 a. Explain the effect of gyroscopic couple on an airplane when propeller turn clockwise when viewed from the rear end aeroplane takes i) left turn ii) right turn. (10 Marks)
- b. A Hartnell governor having a central sleeve spring and two right angled bell crank lever operator at 290rpm and 310rpm for a sleeve lift of 15mm. The sleeve arm and ball arm are 80mm and 120mm respectively. The levers are pivoted at 120mm. From the governor axis and the mass of each ball is 2.5 kg. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine i) loads on the spring of the lower and highest equilibrium speed. ii) stiffener a the spring. (10 Marks)

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17AE/AS44

**Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020**  
**Mechanisms and Machine Theory**

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

**Module-1**

- 1 a. Prove that the minimum number of binary links in a constrained mechanism with simple hinges is four. (04 Marks)
- b. With a neat sketch explain Ackermann steering gear mechanism and condition for correct steering. (10 Marks)
- c. Give the classification of kinematic pairs according to relative motion between links. Also indicate the DoF associated with each pair. (06 Marks)

**OR**

- 2 a. Show how a pantograph mechanism can be used to draw enlarged or reduced size of a circle. (07 Marks)
- b. With a neat sketch, explain whitworth quick return motion mechanism, also show that return stroke is quicker than cutting stroke. (09 Marks)
- c. Determine the mobility of the mechanism give below. (04 Marks)

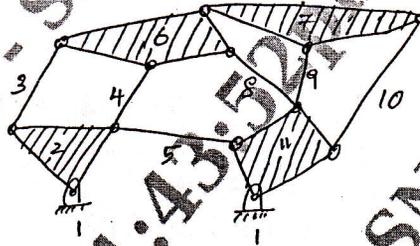


Fig.Q.2(c)

**Module-2**

- 3 A four bar mechanism as shown in the Fig.Q.3 below crank BC rotate with an angular velocity of 100 rad/sec and angular acceleration of 4400 rad/sec<sup>2</sup> of the instant when the crank makes an angle of 53° to the horizontal. Draw the velocity and acceleration polygon and determine the linear acceleration of point E and R, and the angular acceleration of link 3. (20 Marks)

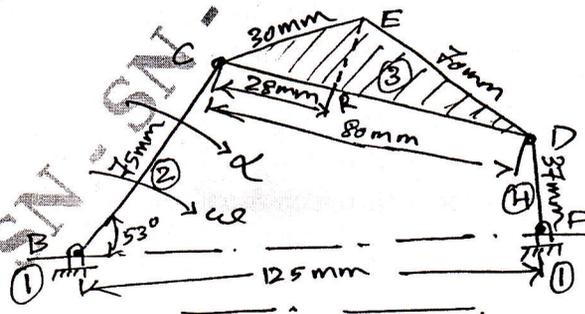


Fig.Q.3

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
 2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

OR

- 4 a. For the static equilibrium of the mechanism, as shown, find the required input torque  $T$ .  
 $DC = 300\text{mm}$ ,  $CE = 100\text{mm}$ . (14 Marks)

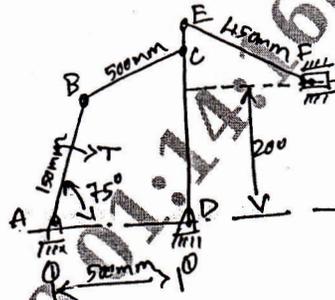


Fig.Q.4(a)

- b. A 4 bar mechanism as shown. Determine the torque  $T$  for state equilibrium by virtual work method.  $AB = 50\text{mm}$ ,  $BC = 66\text{mm}$ ,  $CD = 55\text{mm}$ ,  $CE = 25\text{mm}$ ,  $CF = 30\text{mm}$ ,  $AD = 100\text{mm}$ ,  $P = 500\text{N}$ ,  $Q = 600\text{N}$ . (06 Marks)

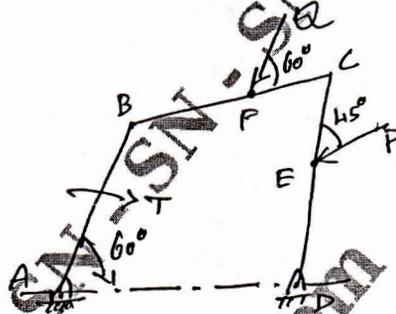


Fig.Q.4(b)

Module-3

- 5 a. With a neat sketch explain spur gear terminology. (08 Marks)  
 b. Pair of spur gears, with number of teeth on pinion = 19, number of teeth on gear = 47,  $\phi = 20^\circ$ ,  $m = 6.5\text{mm}$ , Addendum constant = 1 module. Determine:  
 i) Number of pairs of teeth in contact.  
 ii) Angle turned through by pinion and gear when one pair of teeth is in contact.  
 iii) Ratio of velocity of sliding to rolling velocity of engagement begins, engagement terminates and at pitch point.  
 iv) The length of arc of contact. (12 Marks)

OR

- 6 a. Explain interference and methods to avoid interference. (06 Marks)  
 b. In an epicyclic gear train, the internal wheel A, B and the compound wheel C and D rotate independently about the axis 'O', the wheels E and F rotate on a pin fixed to the arm G. E gears with A and C, F gears with B and D. All have same pitch and number of teeth on E and F are 18, C = 28 and D = 26.  
 i) Sketch the arrangement  
 ii) Find the number of teeth on A and B  
 iii) If the arm G makes 150rpm CW and A is fixed, find speed of B  
 iv) If the arm G makes 150rpm CW and A makes 15rpm CCW. Find speed of B. (14 Marks)

**Module-4**

- 7 A six cylinder two stroke single acting diesel engine with cylinder center lines are spaced at 650mm, in the end view the cranks are  $60^\circ$  apart and in order 1-4-5-2-3-6, the stroke of each piston is 400mm and the crank to C.R. ratio is 1:5. The mass of reciprocating part is 250kg per cylinder and that of rotating part is 100 kg per crank. The engine rotates at 240rpm. Investigate the engine for out of balance primary and secondary force and couples.

(20 Marks)

**OR**

- 8 A shaft carries 4 masses, A = 200kg, B = 300kg, C = 240kg and D = 360kg revolving at 90mm, 70mm, 100mm and 120mm respectively. The distance of plane B, C and D from plane A are 270mm, 420mm and 720mm respectively. Angle between the crank A and B is  $45^\circ$ , B and C is  $75^\circ$ , C and D is  $130^\circ$ . Balancing masses are placed 120mm and 100mm from D and A respectively. The distance between them being 500mm. Find the balancing masses and their angular position if they are placed at a radius of 100mm.

(20 Marks)

**Module-5**

- 9 a. Derive an expression for speed and height of the porter governor. (10 Marks)  
 b. In a hartnell governor the length of ball and sleeve arms are 12 and 10cm respectively. The distance of fulcrum of the hell crank lever from the governor axis is 14cm. Mass of each ball in 4kg. At 300rpm, the ball arm is vertical and sleeve arm is horizontal. For an 4% increase in speed, the sleeve moves up by 10mm. Neglect friction, find:  
 i) Minimum equilibrium speed if total sleeve movement is 20mm  
 ii) Spring stiffness  
 iii) Sensitiveness  
 iv) Spring stiffness if governor is to be isochronous at 300rpm. (10 Marks)

**OR**

- 10 a. With neat sketch explain gyroscopic effect on aeroplane. (10 Marks)  
 b. An aeroplane make a complete half circle of 40m radius towards left when flying at 175km/hr. The mass of the rotary engine and propeller is 400kg with radius of gyration 30mm. The engine runs of 2500rpm CW when viewed from rear. Find the gyroscopic couple and what will be the effect if plane turn right instead of left. (04 Marks)  
 c. Aeroplane engine rotor is supported by bearing 2.14m apart, weighing 688kg (compressor, turbine and shaft). C.G. being at 0.92m from left and radius of gyration 0.229m. Find maximum bearing force on plane when undergoes pullout at 1830 m radius curve at 960km/hr and vector speed 10000rpm. Include centrifugal force effect and gyroscopic effect due to pullout. (06 Marks)

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17AE/AS44

## Fourth Semester B.E. Degree Examination, Aug./Sept. 2020 Mechanisms and Machines Theory

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

### Module-1

- 1 a. With a neat figure, explain crank and slotted lever mechanism. (10 Marks)  
b. Determine mobility of mechanism given below : Fig Q1(b) – (i), and (ii)

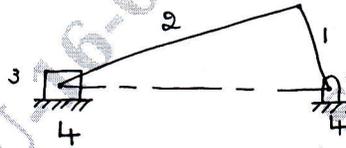


Fig Q1(b)-(i)

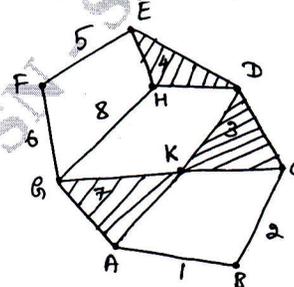


Fig Q1(b)-(ii)

(10 Marks)

OR

- 2 a. Obtain condition for correct steering for a four wheeled vehicle. (10 Marks)  
b. Explain peaucillier's and Geneva wheel mechanism. (10 Marks)

### Module-2

- 3 a. Determine various forces on the link and couple  $T_2$  shown in Fig Q3(a) below. Where  $AB = 300\text{mm}$ ,  $BC = 600\text{mm}$ ,  $BD = 200\text{mm}$ .

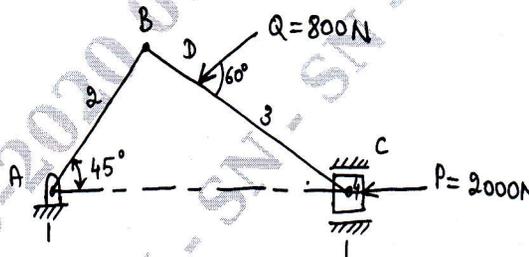


Fig Q3(a)

(16 Marks)

- b. Describe angular velocity and relative velocity. (04 Marks)

OR

- 4 A four bar mechanism ABCD is made up of four links, pin jointed at the ends. AD is a fixed link which is 180mm long. The links AB, BC and CD are 90mm, 120mm and 120mm long respectively. At certain instant, the link AB makes an angle of  $60^\circ$  with the link AD. If the link AB rotates at a uniform speed of 100rpm clockwise determine :

- i) Angular velocity of the links BC and CD  
ii) Angular acceleration of the links CD and CB. (20 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and/or equations written eg.  $42+8=50$ , will be treated as malpractice.

Module-3

- 5 a. State and prove law of gearing. (10 Marks)  
 b. A Pair of spur gear has 16 teeth and 18 teeth, a module 12.5mm, an addendum 12.5mm and a pressure angle  $14.5^\circ$ . Prove that the gears have interference. Determine the minimum number of teeth and the velocity ratio to avoid interference. (10 Marks)

OR

- 6 a. Explain with neat sketches :  
 i) Compound gear train  
 ii) Epicyclic train. (08 Marks)  
 b. An epicyclic gear train is composed of fixed annular wheel A having 150 teeth. Meshing with A is wheel B, which drives wheel D through an Idler wheel C. 'D' being concentric with 'A' wheels B and C are carried on an arm which rotates clockwise at 100rpm about the axis of A and D. If the wheels B and D have 25 and 40 teeth respectively. Find the number of teeth on 'C' and the speed and sense of rotation of 'C'. (12 Marks)

Module-4

- 7 A shaft carries three rotating masses A, B and C of 10, 12 and 15kg respectively. Their radii of rotation are 6cm, 5cm and 8cm from the axis of the shaft. The plane of rotation of masses B and C are 50cm and 80cm from the plane or mass 'A' and on the same side of it. The angular position of masses 'B' and 'C' with respect to mass 'A' are  $75^\circ$  and  $140^\circ$  respectively both measured counter clockwise. If the radius of rotation of mass 'L' and 'M' are to be 10cm. Determine the balancing masses in the planes 'L' and 'M' and their angular position with respect to mass 'A'. The plane 'L' is 20cm to the left of plane 'A' and plane M is 100cm to the right of plane 'A'. (20 Marks)

OR

- 8 a. The pistons of a 4 cylinder vertical inline engine reach their uppermost position at  $90^\circ$  interval in order of their axial position. Pitch of cylinder = 0.35m. Crank radius = 0.12m, length of CR = 0.42m. The engine runs at 600rpm. If the reciprocating parts of each engine has a mass of 2.5kg, find the unbalanced primary and secondary forces couples. Take central plane of engines as reference plane. (14 Marks)  
 b. Why balancing of rotating masses necessary? (06 Marks)

Module-5

- 9 a. Derive an expression for height of porter governor. (08 Marks)  
 b. In a porter governor the upper and lower arms are each 200mm long and are hinged on the mass axis. Each ball weight 25N and the weight of the sleeve is 250N. The force of friction on the sleeve is 25N. The inclination of the arm to the vertical is  $30^\circ$  and  $45^\circ$  in the lowest and height position. Calculate :  
 i) Travel of the sleeve  
 ii) Speed at the bottom, middle and top, taking friction into account during upward travel  
 iii) Speed at the bottom, middle and top, during downward travel, considering friction  
 iv) Speed at the bottom, middle and top of the travel neglecting friction. (12 Marks)

OR

- 10 a. Describe the gyroscopic effect on airplane. (10 Marks)  
 b. An aeroplane makes a complete half circle of 40m radius towards left when flying at 175Km/hr. The mass of rotary engine and propeller is 400Kg with radius of gyration 300mm. The engine runs at 2500rpm clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft. What will be the effect if the aeroplane turns towards right instead of left? (10 Marks)

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