

Kadi Sarva Vishwavidyalaya

B.E. Sem V (Mechanical Engineering)

Subject: Theory of Machines (ME-501)

Date: 09/11/2015

Time: 3 Hrs

Max. Marks: 70

Instructions:

- (1) Answer each section in separate Answer sheet.
- (2) Use of Scientific calculator is permitted.
- (3) All questions are compulsory.
- (4) Indicate clearly, the options you attempt along with its respective question number.
- (5) Assume suitable data if necessary.
- (6) Use the last page of main supplementary of rough work.

Section - I

Q.1

- [A] What is the main function of a governor? How does it differ from flywheel? [5]
Differentiate between inertia and centrifugal governor.
- [B] The lengths of upper and lower arms are 20 cm and 25 cm respectively. Each ball weights 3 kg and the central load is 22.5 kg. for lowest and highest position of the sleeve, the arms are at inclined 30° and 40° respectively to the vertical. The friction at the governor and the mechanism connecting it to the valve is equivalent to a force of 45 N at sleeve. Assuming that links and arms intersect on the axis find: the range of the governor. [5]
- [C] (i) What is a brake? What is the difference between a brake and a clutch? [5]
(ii) What is meant by a self locking and self energized brake?

OR

- [C] "Rope brake type dynamometer is an absorption type dynamometer." Justify this statement. Also explain principle and working of belt transmission dynamometer with neat sketch. [5]

Q.2

- [A] Explain the principle of gyroscopic action and determine the magnitude and direction of gyroscopic couple [4]
- [B] A two wheeler motor vehicle and its rider weight 250 kg and their combined center of gravity is 600 mm above the ground level, when the vehicle is upright. Each road wheel is of 600 mm diameter and has a moment of inertia of 1 kgm². The rotating parts of the engine have a moment of inertia of 0.175 kgm². The engine rotates at 6 times the speed of the road wheels and in the same sense. Determine the angle of heel necessary, when the vehicle is rounding a curve of 50 m radius at a speed of 80 km/hr. [6]

OR

Q.2

- [A] With neat sketch explain gyroscopic effects on ship during steering. [4]
- [B] The mass of a turbine rotor of a ship is 2000 kg and has a radius of gyration of 0.5 m. It rotates at 3000 rpm clockwise when viewed from the stern. Determine the gyroscopic effects in the following cases:
1. If the ship travelling at 30 km/h steers to the right along a curve of 100 m radius.
2. If the ship is pitching and the bow is descending with maximum velocity. The pitching is with simple harmonic motion with periodic time of 50 s and the total angular movement between extreme positions is 12°.

Q.3 [A] Determine braking torque of internal expanding shoe brake. [4]

[B] A simple band brake is applied to a rotating drum outer diameter 450 mm. The lap angle of the band on the drum is 270° . The one end of the lever has the fulcrum pin to which is attached, the one end of the band. Other end of the band is attached to a pin 100 mm from the fulcrum. The co-efficient of friction between the band and drum is 0.25. A braking force of 300 N is applied at a distance of 500 mm from the fulcrum. Determine the brake torque for (i) Counter-clockwise rotation of the drum and (ii) clockwise rotation of drum. [6]

OR

Q.3 [A] Explain Epicyclic Train Dynamometer with neat sketch [5]

[B] A torsion dynamometer is fitted on turbine shaft to measure the angle of twist. It is observed that the shaft twists 1.5° in a length of 5 meter at 500 rpm. The shaft is solid and has a diameter of 200 mm. If the modulus of rigidity for the shaft material is 85 GPa, find the power transmitted by turbine. [5]

Section - II

Q.4 [A] Explain dynamically equivalent two mass systems with neat sketch using analytical method and prove the same using graphical method. [6]

[B] Explain principle of virtual work method for static force analysis. If effect of friction is to be considered can we use this method? [4]

[C] Draw and explain Klein's construction for determining the velocity of the piston in slider crank mechanism [5]

OR

[C] Explain three position synthesis of four bar mechanism. [5]

Q.5 [A] The crank and the connecting rod of a vertical single cylinder gas engine running at 1800 rpm are 60 mm and 240 mm respectively. The diameter of the piston is 80 mm and the mass of reciprocating parts is 1.2 kg. At a point during the power stroke when the piston has moved 20 mm from the top dead center position, the pressure on the piston is 800 kN/m^2 . Determine:

1) Engine speed at which the net force on piston will be zero

[B] Draw and explain turning moment diagram for 4-Stroke single cylinder engine. [5]

OR

Q.5 For the static equilibrium of quick return mechanism shown in Figure 1, determine the input torque T_2 to be applied on link AB for a force of 80N at 150° as shown in fig.1. The pin joint at each pair of link has a pin with diameter of 50 mm and assume co-efficient of friction as 0.15. ignore the thickness of the follower. [10]

The dimensions of the various links are:

AD = 500 mm, AB = 400 mm, BC = 1000 mm, CD = 750 mm, DE = 350 mm

Q.6 [A] Explain Engine force Analysis dynamic in nature. [5]

[B] A horizontal gas turbine 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 weight 20 kg. When the crank has turned through an angle of 30° from the inner dead centre, the gas pressure on the cover and the crank sides are 500 kN/m^2 and 60 kN/m^2 respectively. Diameter of the piston rod is 40 mm. Determine

i. turning moment on the crank shaft

respectively. Diameter of the piston rod is 40 mm. Determine

- i. turning moment on the crank shaft
- ii. thrust on the bearings
- iii. acceleration of the flywheel which has a mass of 8 kg and radius of gyration of 600 mm while the power of the engine is 22 kW

OR

- Q.6 [A] Explain concept of synthesis of mechanism with example. Also explain the [4] following terms : 1) Function generation 2) Dimensional synthesis
- [B] Design a four bar mechanism to co-ordinate given input and output angles. [6]
Assume length of any one of the links as one unit.
Input angles = 20° , 35° and 50° ; Output angles = 35° , 45° and 60°

*****BEST OF LUCK*****

Kadi Sarva Vishwavidyalaya

B.E. Sem V (Mechanical Engineering)

Subject: Theory of Machines (ME-501)

Date: 19/11/2015

Time: 3 Hrs

Max. Marks: 70

Instructions:

- (1) Answer each section in separate Answer sheet.
- (2) Use of Scientific calculator is permitted.
- (3) All questions are compulsory.
- (4) Indicate clearly, the options you attempt along with its respective question number.
- (5) Assume suitable data if necessary.
- (6) Use the last page of main supplementary of rough work.

Section – I

Q.1

- [A] Define the following terms:(i) Sensitiveness (ii) Hunting (iii) Isochronism [6]
- [B] The arms of a porter governor are each 25 cm long and pivoted on the governor axis. Mass of each ball is 5 kg and mass of the central sleeve is 30 kg. The radius of rotation of the balls is 15 cm when the sleeve begins to rise and reaches a value of 20 cm for maximum speed. Determine the range of the governor. [4]
- [C] What is the function of dynamometer? Classify the dynamometers. Explain with neat sketch any one dynamometer. [5]

OR

- [C] A band and block brake having 12 blocks, each of which subtends an angle of 160° at the center, is applied to a rotating drum of diameter 600 mm. The blocks are 75 mm thick. The drum and the flywheel mounted on the same shaft have a mass of 1800 kg and have a combined radius of gyration of 600 mm. The two ends of the band are attached to pins on the opposite sides of the brake fulcrum at distances of 40 mm and 150 mm from the fulcrum. If a force of 250 N is applied at a distance of 900 mm from the fulcrum, find:
1. The maximum braking torque and 2. The angular retardation of the drum
Take coefficient of friction between the blocks and the drum as 0.3.

- Q.2 [A] Explain the principle of gyroscopic action and determine the magnitude and direction of gyroscopic couple [4]

- [B] A two wheeler motor vehicle and its rider weight 225 kg and their combined center of gravity is 600 mm above the ground level, when the vehicle is upright. Each road wheel is of 600 mm diameter and has a moment of inertia of 1 kgm^2 . The rotating parts of the engine have a moment of inertia of 0.175 kgm^2 . The engine rotates at 5.5 times the speed of the road wheels and in the same sense. Determine the angle of heel necessary, when the vehicle is rounding a curve of 30 m radius at a speed of 55 km/hr.

OR

- Q.2 [A] With neat sketch explain gyroscopic effects on aero plane. [4]

- [B] The mass of a turbine rotor of a ship is 8000 kg and has a radius of gyration of 0.75 m. It rotates at 1800 rpm clockwise when viewed from the stern. Determine the gyroscopic effects in the following cases:

1. If the ship travelling at 100 km/h steers to the left along a curve of 80 m radius.
2. If the ship is pitching and the bow is descending with maximum velocity. The pitching is with simple harmonic motion with periodic time of 20 s and the total angular movement between extreme positions is 10° .

3. If the ship is rolling with an angular velocity of 0.03 rad/s clockwise when looking from stern. In each case, determine the direction in which the ship tends to move.

Q.3 [A] Determine braking torque of internal expanding shoe brake. [5]

[B] A simple band brake is applied to a rotating drum outer diameter 600 mm. The lap angle of the band on the drum is 270° . The one end of the lever has the fulcrum pin to which is attached, the one end of the band. Other end of the band is attached to a pin 120 mm from the fulcrum. The co-efficient of friction between the band and drum is 0.25. A braking force of 100 N is applied at a distance of 840 mm from the fulcrum. Determine the brake torque for (i) Counter-clockwise rotation of the drum and (ii) clockwise rotation of drum.

OR

Q.3 [A] What is the main function of a governor? How does it differ from flywheel and Differentiate between inertia and centrifugal governor? [5]

[B] A Hartnell governor having a central sleeve spring and two right angled bell crank lever operates between 290 r.p.m. and 310 r.p.m. for a sleeve lift of 15 mm. The sleeve arms and the ball arms are 80 mm and 120 mm respectively. The levers are pivoted at 120 mm from the governor axis and mass of each ball is 2.5 kg. The ball arms are parallel to the governor axis at the lowest equilibrium speed. Determine stiffness of the spring.

Section - II

Q.4 [A] Explain dynamically equivalent two mass systems with neat sketch using analytical method and prove the same using graphical method. [6]

[B] Draw and explain Klein's construction for determining the velocity of the piston in slider crank mechanism. [4]

[C] Draw and explain turning moment diagram for 4-Stroke single cylinder engine [5]

OR

[C] Design a four bar mechanism to co-ordinate given input and output angles. [5]
Assume length of any one of the links as one unit.
Input angles = 15° , 30° and 45° ; Output angles = 30° , 40° and 55°

Q.5 [A] The crank and the connecting rod of a vertical single cylinder gas engine running at 1800 rpm are 60 mm and 240 mm respectively. The diameter of the piston is 80 mm and the mass of reciprocating parts is 1.2 kg. At a point during the power stroke when the piston has moved 20 mm from the top dead center position, the pressure on the piston is 800 kN/m^2 . Determine:
1) Net force on the piston.
2) Thrust in the connecting rod

[B] Explain principle of virtual work method for static force analysis. If effect of friction is to be considered can we use this method? [5]

OR

- Q.5** For the static equilibrium of quick return mechanism shown in Figure 1, determine [10] the input torque T_2 to be applied on link AB for a force of 450 N on the slider D. The dimensions of the various links are
 $OA = 300 \text{ mm}$, $AB = 200 \text{ mm}$, $OC = 600 \text{ mm}$, $CD = 300 \text{ mm}$

- Q.6** The following data relate to a vertical connecting rod of a reciprocating engine : [10]
- | | |
|---------------------------------------|-------|
| Mass,(kg) | : 55 |
| Distance between bearing centers (mm) | : 850 |
| Diameter of small end bearing (mm) | : 75 |
| Diameter of big end bearing (mm) | : 100 |
- Time of oscillation when connecting rod is suspended from small end(s) 1.83
 Time of oscillation when connecting rod is suspended from big end(s) 1.68
 Find the radius of gyration about an axis through the centre of gravity perpendicular to the plane of oscillation, and The dynamical equivalent system for the connecting rod. Constituted of two masses. One of which is situated at the small end centre.

OR

- Q.6** [A] Explain concept of synthesis of mechanism with example. Also explain the [3] following terms : 1) Function generation 2) Path generation 3) Type synthesis
- [B] The turning moment diagram for a multi cylinder engine has been to drawn to a scale of 1 mm to 500 N-m torque and 1 mm to 6° of crank displacement. The intercepted areas between output torque curve and mean resistance line taken in order from one end in sq. mm are, -30,+410,-280,+320,-330,+250,-360,+280,-260 sq. mm when the engine is running at 800 RPM. The engine has a stroke of 300mm and the fluctuation of speed is not to exceed $\pm 2\%$ of the mean speed. Determine the co-efficient of fluctuation of speed and a suitable diameter and cross section of the Flywheel rim for a limiting value of the safe centrifugal stress of 7 MPa. The material density may be assumed as 7200 Kg/m³. The width of Rim is to be 5 times the thickness.

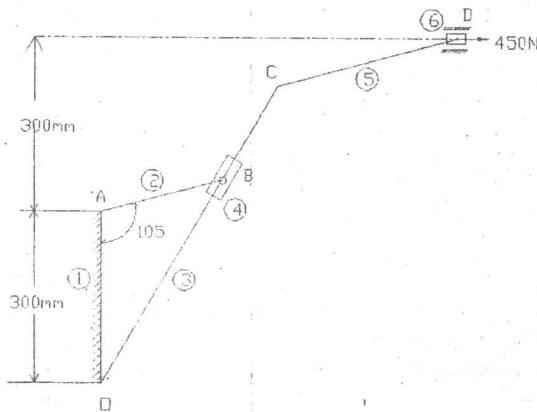


Fig.1

*****BEST OF LUCK*****

KADI SARVA VISHWAVIDHYALAYA
B.E MECHANICAL Semester-V

Subject: Theory of Machines

Date: 12/11/2014

Subject Code: ME501

Time: 10:00 am to 1:00 pm

Total Marks: 70

Instructions:

1. Answer each section in separate Answer sheet.
2. Use of Scientific calculator is permitted.
3. All questions are **Compulsory**.
4. Indicate **clearly**, the options you attempt along with its respective question number.
5. Use the last page of main supplementary of **rough work**.

SECTION-I

- Que:1** (A) Explain the following terms related to Governor [5]
(i) Sensitiveness (ii) Hunting (iii) Stability (iv) Isochronism
(B) A Porter governor has all four arms 250 mm long. The upper arms are attached on the axis of rotation and the lower arms attached to the sleeve at a distance of 40 mm from the axis. The mass of each ball is 6 kg and sleeve has mass of 70 kg. Determine the equilibrium speed of the governor, for the radius of rotation of 200 mm. [5]
(C) A loaded governor of the porter type has equal arms and links each 250 mm long. The mass of each ball is 2 kg and the central mass is 12 kg. When the ball radius is 150 mm, the valve is fully open and when radius is 185 mm the valve is fully closed. Find the maximum speed and the range of speed. If the maximum speed is increased 20 % by an addition of mass to the central load. Find what additional mass is required. [5]

OR

- (C) The following data refers to a Hartnell Governor.
Length of horizontal arms of bell crank lever = 40 mm and length of vertical arms of bell crank lever = 80 mm. Mass of each flying ball 1.2 kg. The maximum radius of rotation = 100 mm, The minimum radius of rotation = 70 mm, The distance of fulcrum to axis of rotation = 75 mm, Minimum equilibrium speed = 400 rpm, Maximum equilibrium speed 5 % higher than minimum equilibrium speed. Neglecting obliquity of arms. Determine (i) Spring stiffness (ii) Initial compression [5]

- Que:2** (A) What is a Relative Pole? Explain Graphically Two position synthesis and Three position synthesis for slider Crank Mechanism. [5]
(B) Design a four bar mechanism to coordinate three positions of the input and the output links as follows (By Function Generation)
 $\Theta_1 = 20^\circ, \theta_2 = 35^\circ, \theta_3 = 50^\circ, \Phi_1 = 35^\circ, \Phi_2 = 45^\circ, \Phi_3 = 60^\circ$. [5]

OR

- (A) Explain Frudennstein's method of three point synthesis of mechanism. [5]
(B) Design a four link mechanism if the motions of the input and the output links are governed by a function $y = x^{1.5}$ and x varies from 1 to 4. Assume Θ to be vary from 30° to 120° and Φ from 60° to 130° . The length of the fixed length is 30 mm. Use Chebychev spacing of accuracy points. [5]

- Que:3** (A) What is meant by Dynamically Equivalent System? State and prove conditions for it. [5]
- (B) The crank and the connecting rod of a vertical single cylinder gas engine running at 1800 rpm are 60 mm and 240 mm respectively. The diameter of the piston is 80 mm and the mass of reciprocating parts is 1.2 kg. At a point during the power stroke when the piston has moved 20 mm from the top dead center position, the pressure on the piston is 800 kN/m^2 . Determine:
 1) Net force on the piston
 2) Thrust in the connecting rod
 3) Thrust on the sides of cylinder walls
 4) Engine speed at which the above values are zero. [5]

OR

- (A) How is the friction at the pin joints and at sliding pairs of mechanism is taken into account. [5]
- (B) A slider-crank mechanism with the following dimensions is acted upon by a force $F = 2 \text{ kN}$ at B as shown in fig. 1: OA = 100 mm, AB = 450 mm. Determine the input torque T on the link OA for the static equilibrium of the mechanism. [5]

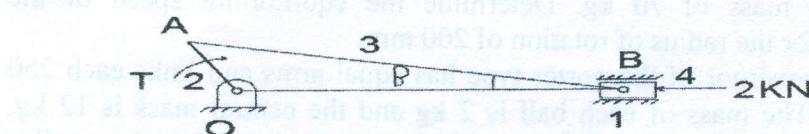


Fig. 1

SECTION-II

- Que:4** (A) Describe the construction and operation of a Prony Brake Absorption Dynamometer. [5]
- (B) What is meant by a Self Locking and Self energized Brake? [5]
- (C) A simple band brake is applied to a rotating drum of diameter 600 mm. The lap angle of the band on the drum is 270° . The one end of the lever has the fulcrum pin to which is attached, the one end of the band. Other end of the band is attached to a pin 120 mm from the fulcrum. The coefficient of friction between the band and drum is 0.25. A Braking force of 100 N is applied at a distance of 840 mm from the fulcrum. Determine the Brake torque for (i) Counter clockwise rotation of the Drum and (ii) clockwise rotation of the Drum. [5]

OR

- (C) In a Belt transmission dynamometer, the driving pulley rotates at 400 rpm. The distance between the center of the driving pulley and dead mass is 820 mm. The diameter of each driving as well as intermediate pulleys [5]

equal to 360 mm. Find the value of the dead mass required to maintain the lever in the horizontal position, when the power transmitted is 5 KW. Also find its value when the belt just begins to slip on the driving pulley. μ being 0.25 and maximum tension in the belt 1500 N.

- Que:5** (A) Explain Gyroscopic couple and establish the relation $C = I \dot{\theta}^2$ [5]
(B) The moment of inertia of an aero plane air screw is 20 kg m^2 and the speed of rotation is 1250 rpm clockwise when viewed from the front. The speed of the Flight is 200 Km/hr. Calculate the gyroscopic reaction of the air screw on the aero plane when it makes a left hand turn on the path of 150 m radius. [5]

OR

- (A) Derive an expression for angle of heel of a two wheeler taking turn. [5]
(B) The turbine rotor of a ship has a mass of 2.2 tones and rotates at 1800 r.p.m. clockwise when viewed from the left. The radius of gyration of the rotor is 320 mm. Determine the gyroscopic couple and the effect when (i) Ship turns right at a radius of 250 m with speed of 25 km/hr. (ii) ship pitches with the bow rising at an angular velocity of 0.8 rad/sec (iii) Ship rolls at angular velocity of 0.1 rad/sec. [5]
- Que:6** (A) Explain in brief the working of Flywheel in Punching press. [5]
(B) The turning moment diagram for a petrol engine is drawn to vertical scale of 1 mm = 5 Nm and the horizontal scale of 1 mm = 1° . The turning moment repeat itself after every half revolution of engine. The area above and below the mean torque line are 305, 710, 50, 350, 980 and 275 mm². The rotating parts amounts to mass of 40 kg at a radius of gyration of 140 mm. calculate the coefficient of fluctuation of speed if the speed of the engine is 1400 rpm. [5]

OR

- (A) What are Turning Moment Diagrams? What information can be avail from them? [5]
(B) A flywheel, which is rotating at a maximum speed of 250 r.p.m and is having radius of gyration as 0.5 m, is attached to a punching press. The press is driven by a constant torque electric motor and punches 750 holes per hour. Each punching operation requires 14000 Nm of energy and takes 1.8 seconds. If the speed of the Flywheel is not to fall below 225 r.p.m. Find (i) Power of the Motor and (ii) Mass of the Flywheel. [5]

Best of luck

KADI SARVA VISHWAVIDHYALAYA
B.E. MECHANICAL EXAMINATION-APRIL/2015

Subject: Theory of Machine

Subject Code: ME501

Total Marks: 70

Instructions:

1. Answer each section in separate Answer sheet.
2. Use of Scientific calculator is permitted.
3. All questions are **Compulsory**.
4. Indicate clearly, the options you attempt along with its respective question number.

Date: 20/04/2015

Time: 10:30 am 1:30 pm

SECTION-I

- Que:1** (A) What is meant by a self locking and a self energized brake? [5]
(B) Describe the construction and operation of a prony rope brake absorption dynamometer. [5]
(C) A simple band brake is applied to a rotating drum outer diameter 600 mm. The lap angle of the band on the drum is 270° . The one end of the lever has the fulcrum pin to which is attached, the one end of the band. The other end of the band is attached to a pin 120 mm from the fulcrum. The co-efficient of friction between the band and drum is 0.25. A braking force of 100 N is applied at a distance of 840 mm from the fulcrum. Determine the brake torque for (i) Counter-clockwise rotation of the drum and (ii) clockwise rotation of drum. [5]

OR

- (C) A torsion dynamometer is fitted to a propeller shaft of a marine engine. It is found that the shaft twists 2° in a length of 20 m at 120 r.p.m. If the shaft is hollow with O.D. = 400 mm and I. D. = 300 mm, and modulus of rigidity of shaft material is 8×10^{10} N/mm². Find the power of the engine. [5]
Que:2 (A) Prove for Watt governor, height of the governor $h = 895/N^2$. Where N is speed of rotation of sleeve. [5]
(B) A porter governor has equal arms 200mm long pivoted on the axis of rotation. The mass of each ball is 3 kg and the mass on the sleeve is 15kg. The ball path is 120 mm when the governor begins to lift and 160mm at the maximum speed. Determine the range of speed. If the fraction at the sleeve is equivalent to a force of 10 N, find the co-efficient of insensitiveness. [5]

OR

- (A) Define (i) Hunting (ii) Sensitiveness (iii) Sleeve lift and (iv) Isochronisms for governor. [5]
(B) Each arm of a Proell governor is 250 mm long and each ball has a mass of 4.5 kg. The central load acting on the sleeve is 30 kg. The pivots of all the arms are 40 mm from the axis of rotation. The vertical height of the governor is 190 mm. The extension links of the lower arms are vertical and the governor speed is 200 RPM when the sleeve is in the mid position. Determine the length of the extension links and the tension in the upper arms. [5]

Que:3 (A) Explain gyroscopic couple and discuss its effect on an aeroplane taking turns when viewed from rear. [5]

(B) The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 rpm clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship. When the ship is steering to left on a curve of 100 m radius at a speed of 36 km/h.

OR

(A) Explain the principle of gyroscopic action and determine the magnitude and direction of gyroscopic couple. [5]

(B) The turbine of rotor of a ship has mass of 3000 kg. & radius of gyration of 0.4 m, and clockwise speed of 2500 r.p.m. when looking from stern. Determine gyroscopic couple and its effect when (i) The ship steers to the left on curve of 100 m radius at a speed of 36 km/hr. and (ii) When the ship is pitching in S.H.M., the bow falling with its maximum velocity. The period of pitching is 40 Sec. and the total angular displacement between the bow extreme positions of pitching is 12° .

[5]

[5]

SECTION-II
Que:4 (A) Explain the term 'turning moment diagram', 'Coefficient of fluctuation of speed and 'Coefficient of fluctuation of energy'. [5]

(B) What is meant by dynamically equivalent system? State and prove conditions for it. [5]

(C) Explain the turning moment diagram for 4 cylinder four stroke cycle internal combustion engine. [5]

OR

(C) What is a function of dynamometer? List out the different types of dynamometers. [5]

Que:5 (A) Prove the Freudenstein's equation for slider crank mechanism. [5]

(B) Define Synthesis. Explain in brief the classification of synthesis. [5]

OR

(A) Explain: Function generation, path generation & motion generation. [5]

(B) Synthesize a function generator to generate a function $y = \sin x$ in the region $0 \leq x \leq 2\pi$, using Chebyshev spacing taking three precession points. Assume initial crank angle, $\theta_i = 30^{\circ}$, initial rocker angle, $\varphi_i = 60^{\circ}$, $\Delta\theta = 60^{\circ}$ and $\Delta\varphi = 90^{\circ}$. Take fixed link length 50 mm. Also draw the mechanism. [5]

Que:6 (A) Differentiate between Flywheel and Governor. [5]

(B) A connecting rod is suspended from the point 25 mm above the small end centre and 650 mm above its C.G. it takes 35 seconds for 20 oscillations. Find dynamically equivalent system of two masses when the mass is located at small end centre. Mass of the connecting rod is 40 Kg. [5]

OR

(A) Explain the turning moment diagram for 4 cylinder four stroke cycle internal combustion engine. [5]

(B) In Internal combustion engine the crank radius is 400 mm and connecting rod is 950 mm long. The diameter of piston is 100 mm and net gas pressure acting on the piston is 15 MPa. Find: 1. Thrust in connecting rod 2. Piston side exhaust 3. Torque acting on the crank shaft. [5]

Best of luck