



Maratha Vidya Prasarak Samaj's

Rajarshi Shahu Maharaj Polytechnic, Nashik

Udoji Maratha Boarding Campus, Near Pumping Station, Gangapur Road, Nashik-13.

RSM POLY

Affiliated to MSBTE Mumbai, Approved by AICTE New Delhi, DTE Mumbai & Govt. of Maharashtra, Mumbai.

Subject: -Theory of Machines (22438)



SYLLABUS

Chapter No.	Name of chapter	Marks With Option
1	Fundamentals and Types of Mechanisms	18
2	Velocity and Acceleration Mechanisms	20
3	Cam and Follower	18
4	Belt, Chain and Gear Drives	20
5	Brakes and Clutches	14
6	Flywheel, Governor and Balancing	14
Total Marks: -		104



BOARD THEORY

PAPER PATTERN

FOR TOM (22438)

Q.1		Attempt any FIVE 5*2=10
	a)	List four inversions of Four bar Chain Mechanism
	b)	State two examples of Kinematic Pair.
	c)	State the necessity of Acceleration diagram of a Mechanism.
	d)	State four applications of Cam and Followers.
	e)	Define - lift of Cam
	f)	List any four applications of clutches
	g)	State the necessity of Balancing mechanical systems.
Q.2		Attempt any THREE 4*3=12
	a)	Draw any one sketch of a Lower pair and a higher Pair. Explain its principle of working.
	b)	Differentiate between Simple and Compound Gear Train
	c)	Explain the construction of spherical faced follower with suitable sketch.
	d)	Explain the construction of Epicyclical gear train using suitable sketch.
Q.3		Attempt any THREE 4*3=12
	a)	Draw neat sketch of the mechanism of pendulum pump and explain its working.



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	b)	Draw the neat sketch of 'Scotch yoke Mechanism'.
	c)	Explain the principle of working of Internal Expanding Brake using neat sketch
	d)	Distinguish between Radial and Cylindrical Cam. Also draw the sketches of both the cams.
	e)	Explain the method of balancing of different masses revolving in the same plane.
Q.4		Attempt any TWO 6*2=12
	a)	Draw the construction of 'Whitworth Quick Return Mechanism'.
	b)	In a Single slider crank mechanism, crank OB=50mm, the length of connecting rod AB=125 mm. The point 'G' is at 60 mm from point 'B'. Crank OB is rotated at 45° from OA. The Crank rotates at 200 rpm, find out the velocity of point 'G' and angular acceleration of AB.
	c)	A cam is to be designed for knife edge follower with following data. Cam lift 40 mm during 90° of cam rotation with SHM, Dwell for 30°, during return stroke 60° of cam rotation by SHM and remaining is for dwell. Draw profile of cam
Q. 5		Attempt any TWO 6*2=12
	a)	Explain the construction of Epicyclical gear train with neat sketch
	b)	In a slider crank mechanism, lengths of crank and connecting rod are 30mm and 120mm respectively. The crank rotates at 180 rpm clockwise. When the crank rotates to 45° from Inner Dead Centre, find the velocity and acceleration of Slider using Klein's construction. Also find angular velocity and acceleration of connecting rod.



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	c)	Draw neat labeled sketch of Hartwell Governor and explain its working.
Q.6		Attempt any TWO 6*2=12
	a)	A leather belt which is 125 mm wide and 6 mm thick, is used for transmitting power from a pulley. The diameter of the pulley is 750 mm and its angular speed is 500 rpm. The angle of lap is 150° and coefficient of friction is 0.3. If the mass of 1 m ³ of leather is 1 kg and stress in the belt is not to exceed 2.75 MPa then find the maximum power that can be transmitted by the belt
	b)	Draw neat labeled sketch of Diaphragm Clutch and explain its working
	c)	Draw Turning Moment diagram for single cylinder 4-stroke petrol engine. Define coefficient of speed. State the need of flywheel.



CLASS TEST - I

PAPER PATTERN

COURSE: - Theory of Machines (22438)

PROGRAMME: -Mechanical Engineering

Syllabus: -

Unit No.	Name of the Unit	Course Outcome (CO)
1	Fundamentals and Types of Mechanisms	CO-438.01
2	Velocity and Acceleration Mechanisms	CO-438.02
3	Cam and Follower	CO-438.03

Q.1	Attempt any FOUR 4*2=8Marks	Course Outcome (CO)
a)	List four inversions of Four bar Chain Mechanism	CO-438.01
b)	State two examples of Kinematic Pair.	CO-438.01
c)	State the necessity of Acceleration diagram of a Mechanism.	CO-438.02
d)	Explain the term i) Slip ii) Creep	CO-438.02
e)	State four applications of Cam and Followers.	CO-438.03
f)	Define - lift of Cam	CO-438.03
Q.2	Attempt any THREE 3*4=12 Marks	
a)	Draw any one sketch of a Lower pair and a higher Pair. Explain its principle of working.	CO-438.01
b)	In a Single slider crank mechanism, crank OB=50mm, the length of connecting rod AB=125	CO-438.02



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	mm. The point 'G' is at 60 mm from point 'B'. Crank OB is rotated at 45° from OA. The Crank rotates at 200 rpm, find out the velocity of point 'G' and angular acceleration of AB.	
c)	Draw a neat sketch of Locomotive coupler mechanism? Explain its working in brief.	CO-438.02
d)	Distinguish between Radial and Cylindrical Cam. Also draw the sketches of both the cams.	CO-438.03



CLASS TEST - II

PAPER PATTERN

COURSE: - Theory of Machines (22657)

PROGRAMME: -Mechanical Engineering

Syllabus: -

Unit No.	Name of the Unit	Course Outcome (CO)
4	Belt, Chain and Gear Drives	CO-438.04
5	Brakes and Clutches	CO-438.05
6	Flywheel, Governor and Balancing	CO-438.06

Q.1	Attempt any FOUR 4*2=8Marks	Course Outcome (CO)
a)	Define slip in belt	CO-438.04
b)	State i) Module ii) Addendum	CO-438.04
c)	Explain the factors on which the capacity of a brake depends	CO-438.05
d)	List any four applications of clutches	CO-438.05
e)	Define the terms used in governors i) Height ii) Sleeve lift	CO-438.06
f)	State the necessity of Balancing mechanical systems.	CO-438.06
Q.2	Attempt any THREE 3*4=12 Marks	
a)	A leather belt which is 125 mm wide and 6 mm	CO-438.04



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	thick, is used for transmitting power from a pulley. The diameter of the pulley is 750 mm and its angular speed is 500 rpm. The angle of lap is 150° and coefficient of friction is 0.3. If the mass of 1 m ³ of leather is 1 kg and stress in the belt is not to exceed 2.75 MPa then find the maximum power that can be transmitted by the belt.	
b)	Explain the construction of Epicyclical gear train with neat sketch	CO-438.04
c)	Draw neat labeled sketch of Diaphragm Clutch and explain its working	CO-438.05
d)	Draw neat labeled sketch of Hartwell Governor and explain its working.	CO-438.06



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COURSE OUTCOME

(CO)

COURSE: - Theory of Machines (22438)

PROGRAMME: -Mechanical Engineering

CO.NO.	Course Outcome
CO-438.01	Identify various links in popular mechanisms.
CO-438.02	Select suitable mechanism for various applications.
CO-438.03	Interpret the motion of cams and followers.
CO-438.04	Recommend relevant belts, chains and drives for different applications.
CO-438.05	Choose relevant brakes and clutches for various applications
CO-438.06	Select suitable flywheel and governor for various applications.



1. Fundamentals and Types of Mechanisms

Position in Question Paper

Total Marks-14

Q.1. a) 2-Marks.

Q.1. b) 2-Marks.

Q.2. a) 2-Marks.

Q.3. a) 4-Marks.

Q.3. b) 4-Marks.

Q.4. a) 4-Marks.

Descriptive Question

1. List four inversions of Four bar Chain Mechanism
2. State two examples of Kinematic Pair
3. Draw any one sketch of a Lower pair and a higher Pair. Explain its principle of working.
4. Draw neat sketch of the mechanism of pendulum pump and explain its working.
5. Draw the neat sketch of 'Scotch yoke Mechanism.
6. Draw the construction of 'Whitworth Quick Return Mechanism'.
7. List any two types of Constrained Motion with suitable examples.
8. List four inversions of Four bar Chain Mechanism
9. Draw neat sketch of the mechanism of pendulum pump and explain its working.



MCQ Question

(Total number of Question=Marks*3=14*3=42)

Note: Correct answer is marked with **bold**.

- The method of obtaining different mechanisms by fixing in turn different links in a kinematic chain, is known as
 - Structure
 - Inversion**
 - Compound Mechanism
 - Machine
- The inversion of a mechanism is
 - Changing of a higher pair to a lower pair
 - Turning its upside down
 - Obtained by fixing different links in a kinematic chain**
 - Obtained by reversing the input and output motion
- In a four bar chain or quadric cycle chain
 - each of the four pairs is a turning pair**
 - one is a turning pair and three are sliding pairs
 - two are turning pairs and two are sliding pairs
 - three are turning pairs and one is a sliding pair
- The mechanism in which two are turning pairs and two are sliding pairs, is called a
 - double slider crank chain
 - elliptical trammel
 - scotch yoke mechanism
 - all of the mentioned**
- A pantograph consists of
 - 4 links**
 - 6 links
 - 8 links
 - 10 link
- A Hooke's joint is used to join two shafts which are
 - aligned
 - intersecting**
 - parallel
 - none of the mentioned
- An exact straight line motion mechanism is a
 - Scott-Russell's mechanism
 - Hart's mechanism**
 - Peaucellier's mechanism
 - All of the mentioned
- The two elements of a pair are said to form a higher pair, when they
 - have a surface contact when in motion
 - have a line or point contact when in motion**



- c) are kept in contact by the action of external forces, when in motion
d) permit relative motion
9. The two elements of a pair are said to form a _____ when they permit relative motion between them.
- a) open pair
b) kinematic pair
c) higher pair
d) lower pair
10. The relation between number of pairs (p) forming a kinematic chain and the number of links (l) is
- a) $l = 2p - 2$
b) $l = 2p - 3$
c) **$l = 2p - 4$**
d) $l = 2p - 5$
11. When the nature of contact between the element of a pair is such that it can only slide relative to the other, the pair is known as a
- a) screw pair
b) spherical pair
c) turning pair
d) sliding pair
12. When the nature of contact between the element of a pair is such that one element can turn about the other by screw threads, the pair is known as a
- a) **screw pair**
b) spherical pair
c) turning pair
d) sliding pair
13. Which of the following is an example of sliding pair
- a) **Piston and cylinder of a reciprocating steam engine**
b) Shaft with collars at both ends fitted into a circular hole
c) Lead screw of a lathe with nut
d) Ball and a socket joint
14. Which of the following is an open pair.
- a) **Ball and socket joint**
b) Journal bearing
c) Lead screw and nut
d) Cam and follower
15. The number of inversions for a slider crank mechanism is
- a) 6
b) 5
c) **4**
d) 3
16. In a kinematic chain, a quaternary joint is equivalent to
- a) one binary joint
b) two binary joint
c) **three binary joint**
d) four binary joint
17. Scotch yoke mechanism is the inversion of
- a) Single slider kinematic chain
b) **Double slider kinematic chain**
c) Four bar chain
d) None of the above



18. What is meant by Kinetics

- a) It deals with the study of relative motion between different components of a machine
- b) It deals with the forces acting on different components
- c) It deals with the inertia forces acting on different components of the engine**
- d) All of the above

19. The crank and lever mechanism will produce

- a) Translating motion
- b) Rotary motion
- c) Oscillating motion**
- d) Zigzag motion

20. The double crank mechanism is used in

- a) Coupling rod of a locomotive**
- b) Beam engine
- c) Pantograph
- d) Watt's indicator mechanism

21. Which of the following is double lever mechanism?

- a) Coupling rod of a locomotive
- b) Beam engine
- c) Pantograph**
- d) Watt's indicator mechanism

22. Which of the following is an inversion of four bar kinematic chain?

- a) Beam engine**
- b) Reciprocating engine
- c) Oscillating engine
- d) Rotary engine

23. Which of the following is an inversion of double slider crank chain.

- a) Beam engine
- b) Reciprocating engine
- c) Whitworth quick return mechanism
- d) Elliptical trammel**

24. Which of the following mechanism is used to connect two parallel shaft when distance between them is small?

- a) Scotch yoke mechanism
- b) Oldham's coupling**
- c) Whitworth quick return mechanism
- d) Elliptical trammel

25. Scotch yoke mechanism is used to convert rotary motion into

- a) Translating motion**
- b) Rotary motion
- c) Oscillating motion
- d) Zig-zag motion

26. If crank is fixed in single slider crank chain, we get

- a) Rotary engine**
- b) Beam engine
- c) Reciprocating engine
- d) Oscillating engine

27. The oscillating cylinder engine can be

- a) Lever
- b) Connecting rod**
- c) Crank
- d) Slider

28. Which of the following is not a type of constrained motions.

- a) Completely
- b) Incompletely
- c) Successfully
- d) Unsuccessfully**

29. Mechanism is a kinematic chain in which

- a) None of the link is fixed
- b) One link is fixed**
- c) Two links are fixed
- d) None of the above

30. A four bar kinematic chain has ____ turning pairs



- a) One
b) Two
c) Three
d) **Four**
31. A single slider kinematic chain has ___ turning pairs and ___ sliding pairs.
a) One, one
b) Two, one
c) **Three, one**
d) Two, two
32. The mechanism forms a structure, when the number of degrees of freedom (n) is equal to
a) **0**
b) 1
c) 2
d) -1
33. A link which makes complete revolution is known as
a) Level
b) Connecting rod
c) Frame
d) **Crank**
34. The fixed link is known as ___ of the mechanism.
a) Level
b) Connecting rod
c) **Frame**
d) Crank
35. _____ is the study to know the displacement, velocity and acceleration of a part of the machine.
a) **Kinematics**
b) Kinetics
c) Statics
d) All of the above
36. In Theory of machines ___ deals with various forces when the body is stationary.
a) Kinematics
b) Kinetics
c) **Statics**
d) All of the above
37. In reciprocating engine, which of the following restraining body does not exist?
a) Connecting rod
b) Crank
c) Slider
d) **Lever**
38. kinematic pair consists of
a) **Two links**
b) Three links
c) Four links
d) Any number of links
39. A kinematic pair cannot be classified according to
a) Nature of contact between the links
b) Type of relative motion between the links
c) Nature of mechanical constraints between the links
d) **Number of links connected**
40. A lower pair has
a) **Surface contact**
b) Line contact
c) Point contact
d) All of the above
41. Ball bearing is an example of
a) **Rolling pair**
b) Sliding pair
c) Turning pair
d) Spherical pair
42. A rigid body in space has ___ degrees of freedom.
a) Two
b) Three



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c) **Six**

d) **Eight**

2- Velocity and Acceleration Mechanisms

Position in Question Paper

Total Marks-10

Q.1. c) 2-Marks.

Q.2. b) 2-Marks.

Q.4. b) 4-Marks.

Q.5. b) 6-Marks.

Descriptive Question

1. State the necessity of Acceleration diagram of a Mechanism
2. Differentiate between Simple and Compound Gear Train.
3. State the necessity of Acceleration diagram of a Mechanism.
4. In a Single slider crank mechanism, crank $OB=50\text{mm}$, the length of connecting rod $AB=125\text{ mm}$. The point 'G' is at 60 mm from point 'B'. Crank OB is rotated at 45° from OA . The Crank rotates at 200 rpm , find out the velocity of point 'G' and angular acceleration of AB .
5. In a slider crank mechanism, lengths of crank and connecting rod are 30mm and 120mm respectively. The crank rotates at 180 rpm clockwise. When the crank rotates to 45° from Inner Dead Centre, find the velocity and acceleration of Slider using Klein's construction. Also find angular velocity and acceleration of connecting rod
6. A crank of slider crank mechanism rotates clock wise at constant speed of 300 rpm . The crank is 150 mm and connecting rod is 600 mm long. Determine: (i) Linear velocity of the midpoint of connecting rod. (ii) Angular acceleration of connecting rod at a crank angle of 45° from inner dead centre position.
7. A 4-bar mechanism has following dimensions: $l(DA)=300\text{ mm}$ $l(CB) = l(AB) = 360\text{ mm}$ $l(DC) = 600\text{ mm}$. The link 'DC' is fixed. The angle ADC is 60° The driving link 'DA' rotates at a speed of 100 rpm clockwise and constant driving torque is 50 N.M . Calculate the Velocity of point 'B' and angular velocity of driven link 'CB'.

MCQ Question

(Total number of Question=Marks*3=10*3=30)

- The instantaneous centers of a slider moving in a curved surface lies at
 - infinity
 - their point of contact
 - the center of curvature**
 - the pin point
- The fixed instantaneous center of mechanism
 - varies with the configuration
 - remains at the same place for all configurations**
 - all of the mentioned
 - none of the mentioned
- The instantaneous center of rotation of a circular disc rolling on a straight path is
 - at the center of the disc
 - at their point of contact**
 - at the center of gravity of the disc
 - at infinity
- The locus of instantaneous center of a moving body relative to a fixed body is known as the
 - space centrode**
 - body centrode
 - moving centrode
 - none of the mentioned
- The space centrode of a circular disc rolling on a straight path is
 - circle
 - parabola
 - a straight line**
 - none of the mentioned
- The component of the acceleration directed towards the center of rotation of a revolving body is known as _____ component.
 - tangential
 - centripetal**
 - coriolis
 - none of the mentioned
- At an instant, if the angular velocity of a link is clockwise then the angular acceleration will be
 - clockwise
 - counterclockwise
 - in any direction**
 - none of the mentioned
- Angular acceleration of a link AB is given by
 - centripetal acceleration/length
 - tangential acceleration/length**
 - total acceleration/length
 - none of the mentioned
- Klein's construction is useful to determine.....
 - crank has a uniform angular velocity
 - crank has non-uniform angular velocity**
 - crank has uniform angular acceleration
 - crank has uniform angular velocity and angular acceleration
- Kelin's construction gives a graphical construction for.....
 - slider-crank mechanism
 - velocity polygon
 - acceleration polygon**
 - four bar chain mechanism.
- $(\omega \cos \theta) / n$ is the formula used to calculate



- a) Zero
b) **One**
- c) Infinity
d) 0.5
24. The fundamental function of a tachometer is the conversion of angular _____ into voltage
- a) **Velocity**
b) Displacement
c) Acceleration
d) Current
25. Laplace transform of an impulse response is regarded as _____ function of the system
- a) Analytic
b) Parabolic
c) **Transfer**
d) Hypothetical
26. Which among the following are the elements of rotational motion
- a) **Mass, Spring, Friction**
b) Inertia, Damper, Spring
c) Work, Energy, Power
d) Force, Pressure, Viscosity
27. The fundamental function of a tachometer is the conversion of angular _____ into voltage
- a) **Velocity**
b) Displacement
c) Acceleration
d) Current
28. The crankshaft of reciprocating engine having a 20 cm crank and 100 cm connecting rod rotates at 210 r.p.m. When the crank angle is 45° , the velocity of piston is nearly
- a) 1.8m/s
b) 1.9m/s
c) **3.5m/s**
d) 19m/s
29. In a crank and slotted lever quick-return motion, the distance between the fixed centres is 150 mm and the length of the driving crank is 75mm. the ratio of the time taken on the cutting and return strokes is
- a) 1.5
b) **2.0**
c) 2.2
d) 2.93
30. The speed of driving shaft of a Hooke's Joint of angle 19.5° is 500 r.p.m. The maximum speed of the driven shaft is nearly
- a) 168 r.p.m.
b) 444 r.p.m.
c) 471 r.p.m.
d) **531 r.p.m.**

3. Cam and Follower

Position in Question Paper

Total Marks-10

Q.1. a) 2-Marks.

Q.1. b) 2-Marks.

Q.2. c) 4-Marks.

Q.3. d) 4-Marks.

Q.4. c) 6-Marks.

Descriptive Question

1. State four applications of Cam and Followers.
2. Define - lift of Cam.
3. Explain the construction of spherical faced follower with suitable sketch.
4. Distinguish between Radial and Cylindrical Cam. Also draw the sketches of both the cams.
5. A cam is to be designed for knife edge follower with following data. Cam lift 40 mm during 90° of cam rotation with SHM, Dwell for 30° , during return stroke 60° of cam rotation by SHM and remaining is for dwell. Draw profile of cam
6. Draw the profile of cam operating a knife edged follower from following data:
 - (i) Follower to move outwards through 40mm during 60° of cam rotation.
 - (ii) Follower dwell for next 45° .
 - (iii) Follower to return to its original position during next 90° .
 - (iv) Follower to dwell for rest of the rotation.

The displacement of follower is to take place with simple harmonic motion during both outward and return strokes. The least radius of cam is 50 mm. If the cam rotates at 300 rpm.



MCQ Question

(Total number of Question=Marks*3=12*3=36)

- Calculate the limiting speed to avoid cam jump, if an eccentric plate circular cam has eccentricity of 30 mm and provides motion to the follower of 4 kg mass. Stiffness of the spring is 30 N/mm². Preload in the spring is 600 N
 - 70.81 rad/sec
 - 60.76 rad/sec
 - 141.42 rad/sec**
 - None of the above
- Which motion of follower is best for high speed cams
 - SHM follower motion
 - Uniform acceleration and retardation of follower motion
 - Cycloidal motion follower**
 - All of the above
- Which of the following statements is false for SHM follower motion
 - SHM can be used only for moderate speed purpose
 - The acceleration is zero at the beginning and the end of each stroke**
 - The jerk is maximum at the mid of each stroke
 - Velocity of follower is maximum at the mid of each stroke
- Which of the following conditions can be used to minimize undercutting in cam and follower mechanism
 - By using larger roller diameter
 - By using internal cams**
 - By decreasing the size of the cam
 - All of the above
- To avoid jump phenomenon, which of the following condition should be true
 - $\omega > \sqrt{(me) / (P + 2 ke)}$
 - $\omega > \sqrt{(P + 2 ke) / (me)}$
 - $\omega < \sqrt{(P + 2 ke) / (me)}$**
 - $\omega < \sqrt{(me) / (P + 2 ke)}$
- A cam operating roller follower has the following dimensions, radius of base and nose circle as 15 mm and 10 mm respectively and distance between them is 8 mm. Determine lift made by the follower
 - 5 mm
 - 12.5 mm
 - 3 mm**
 - 17 mm
- The size of a cam depends upon
 - base circle**
 - pitch circle
 - prime circle
 - pitch curve
- The angle between the direction of the follower motion and a normal to the pitch curve is called
 - pitch angle
 - prime angle
 - base angle
 - pressure angle**

9. A circle drawn with centre as the cam centre and radius equal to the distance between the cam centre and the point on the pitch curve at which the pressure angle is maximum, is called
- a) base circle
b) pitch circle
c) prime circle
d) none of the mentioned
10. The cam follower generally used in automobile engines is
- a) knife edge follower
b) flat faced follower
c) spherical faced follower
d) roller follower
11. The cam follower extensively used in air-craft engines is
- a) knife edge follower
b) flat faced follower
c) spherical faced follower
d) roller follower
12. In a radial cam, the follower moves
- a) in a direction perpendicular to the cam axis**
b) in a direction parallel to the cam axis
c) in any direction irrespective of the cam axis
d) along the cam axis
13. A radial follower is one
- a) that reciprocates in the guides**
b) that oscillates
c) follower translates along an axis passing through the cam centre of rotation.
d) none of the mentioned
14. Offset is provided to a cam follower mechanism to
- a) minimise the side thrust**
b) accelerate
c) avoid jerk
d) none of the mentioned
15. For low and moderate speed engines, the cam follower should move with
- a) uniform velocity
b) simple harmonic motion
c) uniform acceleration and retardation
d) cycloidal motion
16. For high speed engines, the cam follower should move with
- a) uniform velocity
b) simple harmonic motion
c) uniform acceleration and retardation
d) cycloidal motion
17. Which of the following displacement diagrams should be chosen for better dynamic performance of a cam-follower mechanism ?
- a) simple harmonic motion
b) parabolic motion
c) cycloidal motion
d) none of the mentioned
18. The linear velocity of the reciprocating roller follower when it has contact with the straight flanks of the tangent cam, is given by
- a) $\omega(r_1 - r_2)\sin\theta$
b) $\omega(r_1 - r_2)\cos\theta$
c) **$\omega(r_1 + r_2)\sin\theta\sec^2\theta$**
d) $\omega(r_1 + r_2)\cos\theta\csc^2\theta$
19. The displacement of a flat faced follower when it has contact with the flank of a circular arc cam, is given by



- c) through which, the cam rotates during the period in which the follower remains in the highest position
- d) moved by the cam from the instant the follower begins to rise, till it reaches its highest position
28. For the same lift and same angle of ascent, a smaller base circle will give _____
- a) a small value of pressure angle
b) **a large value of pressure angle**
c) no such relation with pressure angle
d) something else
29. Cylindrical cams can be classified as _____
- a) circular
b) tangent
c) reciprocating
d) **none of the above**
30. A circle passing through pitch point with its center on cam axis is known as _____
- a) pitch circle
b) base circle
c) **prime circle**
d) outer circle
31. Cam size depends upon _____
- a) **base circle**
b) pitch circle
c) prime circle
d) outer circle
32. The maximum value of the pressure angle in case of cam is kept as _____
- a) 10°
b) 14°
c) 20°
d) **30°**
32. Klein's construction is useful to determine _____
- a) velocity of various parts
b) **acceleration of various parts**
c) displacement of various parts
d) angular acceleration of various parts
33. The sense of Coriolis's component is such that it _____
- a) **leads sliding velocity vector by 90°**
b) lags the sliding velocity vector by 90°
c) is along the sliding velocity vector
d) leads sliding velocity vector by 180°
34. The locus of a point on a thread unwound from a cylinder will be _____
- a) a circle
b) a straight line
c) **involute**
d) cycloidal
35. Calculate the limiting speed to avoid cam jump, if an eccentric plate circular cam has eccentricity of 30 mm and provides motion to the follower of 4 kg mass. Stiffness of the spring is 30 N/mm^2 . Preload in the spring is 600 N
- a) 70.81 rad/sec
b) 60.76 rad/sec
c) **141.42 rad/sec**
d) None of the above
36. Which of the following statements is/are true for cam profile
- a) Pitch point on the pitch curve has minimum pressure angle
b) **In case of roller follower, trace point represents centre of the roller**
c) Pitch circle is drawn through trace point from the center of cam
d) All of the above



4. Belt, Chain and Gear Drives

Position in Question Paper

Total Marks-14

Q.2. b) 4-Marks.

Q.2. c) 4-Marks.

Q.5. a) 6-Marks.

Q.6. a) 6-Marks.

Descriptive Question

1. Differentiate between Simple and Compound Gear Train.
2. Explain the construction of Epicyclic gear train using suitable sketch.
3. Explain the construction of Epicyclic gear train with neat sketch
4. A leather belt which is 125 mm wide and 6 mm thick, is used for transmitting power from a pulley. The diameter of the pulley is 750 mm and its angular speed is 500 rpm. The angle of lap is 150° and coefficient of friction is 0.3. If the mass of 1 m³ of leather is 1 kg and stress in the belt is not to exceed 2.75 MPa then find the maximum power that can be transmitted by the belt.

MCQ Question

(Total number of Question=Marks*3=14*3=42)

- The velocity of the belt for maximum power is
 - $\sqrt{T/3m}$
 - $\sqrt{T/4m}$
 - $\sqrt{T/5m}$
 - $\sqrt{T/6m}$
- The power transmitted by a belt is maximum when the maximum tension in the belt (T) is equal to
 - T_c
 - $2T_c$
 - $3T_c$
 - $4T_c$
- The centrifugal tension in belts
 - increases power transmitted
 - decreases power transmitted
 - have no effect on the power transmitted**
 - increases power transmitted upto a certain speed and then decreases
- The belt slip occurs due to
 - Heavy load
 - Loose belt
 - Driving pulley too small
 - Any one of the above**
- The stress induced in the belt is,
 - tensile stress**
 - compressive stress
 - direct shear stress
 - torsional shear stress
- The suitable material for belt in agricultural machinery is
 - leather
 - rubber**
 - cotton duck
 - balata gum
- Power is transmit by belt is dependent on
 - Arc Contact between belt and pulley
 - Velocity of belt.
 - Tension under which the belt
 - All of these**
- Coefficients of friction between belt pulley is depend on the...
 - Slip of belt
 - Speed of belt
 - Material of belt
 - All of these**
- If speed of belt is increased then..
 - Coefficients friction between belt and pulley is decreased.
 - Coefficients friction between belt and pulley is Increased.
 - Power transmission is decreased.**
 - Power transmission is Increased.

10. In belt drive idler pulley is used for..
- a) **For applying tension.**
 - b) Increased velocity ratio.
 - c) Changing direction.
 - d) Increased life of pulley.
11. All Stress produce on belt are the....
- a) **Tensile stress**
 - b) Compressive stress
 - c) Shear stress
 - d) Bending stress
12. Including angle of v-belt is usually....
- a) 10° to 20°
 - b) 20° to 30°
 - c) **30° to 40°**
 - d) 40° to 50°
13. The power transmitted by a belt drive is (T_1 =Tension on tight side, T_2 =Tension on slack side, where v = linear velocity, ω = angular velocity)
- a) **$(T_1 - T_2) \times v$**
 - b) $(T_1 - T_2) \times \omega$
 - c) $(T_1 - T_2) / v$
 - d) $(T_1 - T_2) / \omega$
14. The angle of contact (θ) for crossed belt drive is given by
- a) $180 - 2\alpha$
 - b) **$180 + 2\alpha$**
 - c) $180 - \alpha$
 - d) $180 + \alpha$
15. The ratio of tension of two sides of a flat belt is given by
- a) $e^{-\mu\theta}$
 - b) **$e^{\mu\theta}$**
 - c) $e \times \mu \times \theta$
 - d) None of the above
16. Crowning of a pulley is done to
- a) **Prevent the slipping of a belt**
 - b) To increase the tension of a belt
 - c) To increase the angle of contact
 - d) None of the above
17. In case of V-belt drive the belt makes contact at
- a) the bottom of groove in the pulley
 - b) the bottom and the sides of groove in the pulley
 - c) **the sides of groove in the pulley**
 - d) none of the above
18. A chain drives is used for
- a) short distance
 - b) long distance
 - c) medium distance
 - d) **no criterion for chain drive**
19. The number of teeth on sprocket should be odd in order to
- a) Reduce polygonal effect
 - b) Reduce wear
 - c) Reduce back sliding
 - d) **wear on all sprocket teeth**
20. Silent chain is made of
- a) Links and blocks
 - b) Links, pins, bushes and rollers
 - c) Links
 - d) **Inverted tooth overlapping links**



- c) Above the pitch circle
d) At the root circle
32. Which of the following type of drives transmit power by friction
a) Spur gear drive
b) Chain drive
c) Worm gear drive
d) Belt drive
33. When the axes of two shafts are non-parallel and non-intersecting, use
a) Helical gears
b) **Crossed helical gears**
c) Straight bevel gears
d) Spiral bevel gear
34. When the axes of two shafts are perpendicular and non-intersecting, use
a) Spur gears
b) Bevel gears
c) **Worm gears**
d) Helical gears
35. The gear tooth system that will transmit very high load is
a) **20° full depth involute**
b) 20° full stub involute
c) 14.5° full depth involute
d) 14.5° stub involute
36. When the axes of two shafts are parallel, use
a) Crossed helical gears
b) Bevel gears
c) Worm gears
d) Spur or helical gears
37. Cycloidal tooth gears are used in
a) Automobile gearbox
b) Machine tool gearbox
c) **Spring driven watches and clocks**
d) Materials handling equipment
38. A rack is a gear with,
a) **Infinite number of teeth**
b) Infinite module
c) Infinite circular pitch
d) None of the above
39. Which of the following type of gears are free from axial thrust
a) **herringbone gears**
b) bevel gears
c) worm gears
d) helical gears
40. Maximum gear ratio for a pair of spur gears is
a) **10**
b) 3
c) 100
d) 6
41. Addendum of a cycloidal gear tooth is
a) **Epicycloid**
b) Hypocycloid
c) Cycloid
d) Involute
42. The initial contact in helical gears is
a) **Point**
b) Surface
c) Line
d) Unpredictable

5. Brakes and Clutches

Position in Question Paper

Total Marks-08

Q.1. a) 2-Marks.

Q.2. c) 4-Marks.

Q.6. b) 6-Marks.

Descriptive Question

1. List any four applications of clutches.
2. Explain the principle of working of Internal Expanding Brake using neat sketch.
3. Draw neat labeled sketch of Diaphragm Clutch and explain its working
4. Explain the construction of 'Disc brake' with neat sketch.
5. Differentiate between belt drive and gear drive
6. Draw the constructional details diagram of centrifugal clutch. Explain its working principle
7. Two parallel shafts whose centre lines are 4.8 m apart are connected by open belt drive. The diameter of larger pulley is 1.5 m and that of smaller pulley 1 m. The initial tension in the belt when stationary is 3 kN. The mass of the belt is 1.5 kg/m length. The coeff of friction between belt and pulley is 0.3. Taking centrifugal tension in to account. Calculate power transmitted when smaller pulley rotates at 400 rpm.
8. Two pulleys one 450 mm diameter and the other 200 mm diameter are on parallel shafts 1.95 m apart and are connected by a crossed belt. Find the length of belt required and angle of contact between belt and each pulley. Estimate the power transmitted by belt when the larger pulley rotates at 200 rpm. If the maximum tension in the belt is 1 kN and coeff of friction between belt and pulley is 0.25



MCQ Question

(Total number of Question=Marks*3=08*3=24)

1. When brakes are applied on a moving vehicle; the kinetic energy is converted to
 - a) Mechanical energy
 - b) Heat energy**
 - c) Electrical energy
 - d) Potential energy
2. The following is not a drum brake
 - a) External contracting brake
 - b) Internal expanding brake
 - c) Disc brake**
 - d) All of the above
3. The hand brake of the automobile is usually
 - a) External contracting brake**
 - b) Internal expanding brake
 - c) Disc brake
 - d) All of the above
4. In disc brake, the disc is attached to the
 - a) wheel
 - b) axle**
 - c) suspension system
 - d) none of the above
5. The mechanical brakes are operated by means of
 - a) levers
 - b) bell cranks
 - c) cams
 - d) all of the above**
6. In vacuum brake, cylinder chamber consists of
 - a) atmospheric valve
 - b) vacuum valve
 - c) both (a) and (b)**
 - d) None of the above
7. Hydraulic brakes function on the principle of
 - a) Law of conservation of momentum
 - b) Law of conservation of energy
 - c) Pascal's law**
 - d) None of the above
8. Tandem master cylinder consists of
 - a) one cylinder and one reservoir
 - b) two cylinders and one reservoir
 - c) one cylinder and two reservoirs
 - d) two cylinders and two reservoirs**
9. Hand brake is applicable to
 - a) only front wheels
 - b) only rear wheels**
 - c) both front and rear wheels
 - d) all of the above
10. Servo action is to
 - a) the amplification of braking forces**
 - b) increase force of friction between shoe and wheel
 - c) transfer of weight during stop
 - d) All of the above
11. The power brake may be exerted by
 - a) electrical energy**
 - b) engine vacuum
 - c) air pressure
 - d) all of the above
12. The process of removing air from the brake system is known as
 - a) bleeding**
 - b) self energizing



- c) servo action
d) energization
13. The following is not a Friction clutch
a) **Fluid clutch**
b) Centrifugal clutch
c) Cone clutch
d) Disc clutch
14. The following type of arrangement is used in synchromesh type gear box
a) Single plate clutch
b) Fluid clutch
c) **Dog clutch**
d) Semi-centrifugal clutch
15. The torque which a clutch can transmit, depends upon the
a) coefficient of friction
b) spring force
c) contact surfaces
d) **all of the above**
16. In Disc clutch, the clutch disc acts as a
a) driving member
b) **driven member**
c) neutral member
d) any of the above
17. In Disc clutch, engine flywheel acts as a
a) **driving plate**
b) driven plate
c) pressure plate
d) none of the above
18. The following is an automatic clutch which is controlled by engine speed
a) Cone clutch
b) **Centrifugal clutch**
c) fluid clutch
d) Disc clutch
19. The following is also known as flywheel or coupling
a) **Centrifugal clutch**
b) Fluid clutch
c) Cone clutch
d) All of the above
20. Clutch and friction linings are ____ to the clutch plate
a) **riveted**
b) welded
c) bolted
d) any of the above
21. The following is (are) the type(s) of clutch linings
a) Solid woven
b) Moulded type
c) Laminated
d) **all of the above**
23. Jaw clutch is a.....
a) **Positive clutch**
b) Friction clutch
c) Disc clutch
d) Cone clutch
24. If contacting surface is 6 then number of disc used in multi plate clutch is.....
a) 5
b) 6
c) **7**
d) 8

6. Flywheel, Governor and Balancing

Position in Question Paper

Total Marks-12

Q.1. g) 2-Marks.

Q.3. e) 4-Marks.

Q.6. c) 6-Marks.

Descriptive Question

1. State the necessity of Balancing mechanical systems.
2. Explain the method of balancing of different masses revolving in the same plane
3. Draw Turning Moment diagram for single cylinder 4-stroke petrol engine.
Define coefficient of speed. State the need of flywheel.
4. Explain the following terms of centrifugal governor with neat sketch:
 - (i) Height of governor
 - (ii) Equilibrium speed
 - (iii) Sleeve lift
5. State the necessity of Balancing. List different types of Balancing methods
6. The weights of four masses A, B, C, D are 200 kg, 300 kg, 240 kg, 260 kg respectively. The corresponding radii of rotation are 200 mm, 150 mm, 250 mm and 300 mm respectively and the angle between successive masses are 45° , 75° and 135° . Find the position and magnitude of the balance weight required if its radius of rotation is 200 mm

MCQ Question

(Total number of Question=Marks*3=12*3=36)

1. A flywheel is used
 - a) **to limit the fluctuation of speed during each cycle**
 - b) to control the mean speed of the engine
 - c) to maintain a constant speed
 - d) to come into action when the speed varies
2. A flywheel is made of
 - a) cast iron
 - b) high strength steels
 - c) graphic fiber reinforced polymer
 - d) **any one of the above materials**
3. The maximum fluctuation of energy of flywheel is
 - a) **difference between maximum and minimum kinetic energy during the cycle**
 - b) difference between maximum and mean kinetic energy during the cycle
 - c) difference between mean and minimum kinetic energy during the cycle
 - d) mean of maximum and minimum kinetic energy during the cycle
4. The rim of the flywheel is subjected to,
 - a) **direct tensile stress and bending stress**
 - b) torsional shear stress and bending stress
 - c) direct shear stress and bending stress
 - d) compressive stress and bending stress
5. The spokes of the flywheel are subjected to
 - a) direct shear stress
 - b) torsional shear stress
 - c) **tensile stress**
 - d) compressive stress
6. The hub diameter of the flywheel is taken as
 - a) 2.5 (shaft diameter)
 - b) 1.5 (shaft diameter)
 - c) 4 (shaft diameter)
 - d) **2 (shaft diameter)**
7. For finding out the bending moment for the arm (spoke) of flywheel the arm is assumed as
 - a) a cantilever beam fixed at the rim and subjected to tangential force at the hub
 - b) a simply supported beam fixed at hub and rim and carrying uniformly distributed load
 - c) **a cantilever hub fixed at the rim and subjected to tangential force at the rim**
 - d) a fixed beam fixed at hub and rim and carrying uniformly distributed load
8. The cross section of flywheel arm is
 - a) I section
 - b) Rectangular
 - c) **Elliptical**
 - d) Circular
9. The coefficient of fluctuation of energy of flywheel is
 - a) **ratio of maximum fluctuation of energy to work done per cycle**
 - b) ratio of to work done per cycle to maximum fluctuation of energy
 - c) difference between maximum and minimum kinetic energy during the cycle

- d) ratio of maximum and minimum kinetic energy during the cycle
10. The coefficient of fluctuation of speed of flywheel is
- a) ratio of maximum and minimum speeds during the cycle
 - b) ratio of maximum fluctuation of speed to the mean speed**
 - c) ratio of mean speed to maximum fluctuation of speed during the cycle
 - d) sum of maximum fluctuation of speed and the mean speed
11. In vehicle flywheel is placed between
- a) clutch and propeller shaft
 - b) engine and clutch**
 - c) before engine
 - d) propeller shaft and differential
12. Energy stored in flywheel in the form of
- a) heat energy
 - b) kinetic energy**
 - c) solar energy
 - d) thermal energy
13. Flywheel is used in
- a) drilling machine
 - b) milling machine
 - c) surface grinder
 - d) punch press**
14. The flywheel is accelerated when
- a) driving torque > load torque**
 - b) driving torque < load torque
 - c) driving torque = load torque
 - d) driving torque / load torque
15. Maximum fluctuation of energy =
- a) Max KE – Min KE**
 - b) Max KE + Min KE
 - c) Max KE > Min KE
 - d) Max KE < Min KE
16. Reciprocal of coefficient of fluctuation of speed is called
- a) fluctuation of energy
 - b) fluctuation of speed
 - c) maximum fluctuation of speed
 - d) coefficient of fluctuation of speed**
17. Split flywheel is made to
- a) avoid cooling stress**
 - b) reduce weight
 - c) increase weight
 - d) maximize large centrifugal force
18. A flywheel connected to a punching machine has to supply energy of 400 Nm while running at a mean angular speed of 20 rad/s. If the total fluctuation of speed is not exceeded to _____ the mass moment of inertia of the flywheel in kgm^2 is
- a) 25**
 - b) 50
 - c) 100
 - d) 125
19. A circular solid of uniform thickness 20 mm, radius 200 mm and mass 20 kg, is used as a flywheel. If it rotates at 600 rpm, the kinetic energy of the flywheel, in joules is
- a) 395
 - b) 790**
 - c) 1580
 - d) 3160
20. Which of the following is used to control the speed variations of the engine caused by the fluctuations of the engine turning moment?
- a) D-slide valve
 - b) Governor
 - c) Flywheel**
 - d) Meyer's expansion valve
21. The radius of Gyration (k) for Rim Type Flywheel having radius 'r' is given by



- a) $k = 2r$
b) $k = r/2$
- a) $k = r$
d) $k = r/3$
22. The coefficient of fluctuation of speed of Flywheel is given by
a) $(N_1 - N_2)/N$
b) $(N_1 + N_2)/N$
c) $(N_1 - N_2) \times N$
d) $(N_1 + N_2) \times N$
23. When the driving torque is more than load torque, flywheel is _____
a) **Accelerated**
b) Decelerated
c) Constant velocity
d) Can't be determined
24. Calculate the coefficient of fluctuation of speed if maximum speed is 2500rpm and minimum speed is 1800rpm.
a) 1.44
b) 1.33
c) **0.33**
d) 0.44
25. A flywheel of moment of inertia 9.8 kgm^2 fluctuates by 30 rpm for a fluctuation in energy of 1936 joules. The mean speed of flywheel is (in rpm)
a) **600**
b) 900
c) 968
d) 2940
26. The height of a Watt's governor is equal to
a) $8.95/N^2$
b) $89.5/N^2$
c) **$895/N^2$**
d) $8950/N^2$
27. The height of a Watt's governor is
a) directly proportional to speed
b) directly proportional to (speed)
c) inversely proportional to speed
d) **inversely proportional to (speed)**
28. A Watt's governor can work satisfactorily at speeds from
a) **60 to 80 r.p.m**
b) 80 to 100 r.p.m
c) 100 to 200 r.p.m
d) 200 to 300 r.p.m
29. When the sleeve of a porter governor moves upwards, the governor speed
a) **increases**
b) decreases
c) remains unaffected
d) first increases and then decreases
30. A Hartnell governor is a
a) dead weight governor
b) pendulum type governor
c) **spring loaded governor**
d) inertia governor
31. Which of the following is a pendulum type governor
a) **Watt's governor**
b) Porter governor
c) Hartnell governor
d) None of the mentioned
32. A Hartnell governor is a
a) pendulum type governor
b) **spring loaded governor**
c) dead weight governor
d) inertia governor
33. Which of the following governor is used to drive a gramophone
a) Watt governor
b) Porter governor
c) **Pickering governor**
d) Hartnell governor
34. In a Hartnell governor, if a spring of greater stiffness is used, then the governor will be



a) more sensitive

c) isochronous

b) less sensitive

d) none of the mentioned

35. A governor is said to be hunting, if the speed of the engine

a) remains constant at the mean speed

b) is above the mean speed

c) is below the mean speed

d) fluctuates continuously above and below the mean speed

36. Isochronism in a governor is desirable when

a) the engine operates at low speeds

b) the engine operates at high speeds

c) the engine operates at variable speeds

d) one speed is desired under one load