Q. Code:920343

Reg. No. | | | | | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Fourth Semester

ME22402 – KINEMATICS OF MACHINERY

(Mechanical Engineering)

(Regulation 2022)

TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Learners will be able to classify the mechanisms involved in various applications.	**3**
CO 2	Learners will be able to select, configure, and synthesize linkages into complete mechanisms.	**3**
CO 3	Learners will be able to apply the concept of kinematics for robot motion control	**3**
CO 4	Learners will be able to calculate the relevant kinematic parameters of cam and gear mechanisms.	**3**
CO 5	Learners will be able to apply the concepts of friction in real time applications.	**3**

PART- A (20 x 2 = 40 Marks)

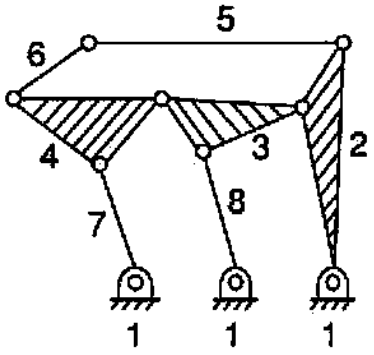
(Answer all Questions)

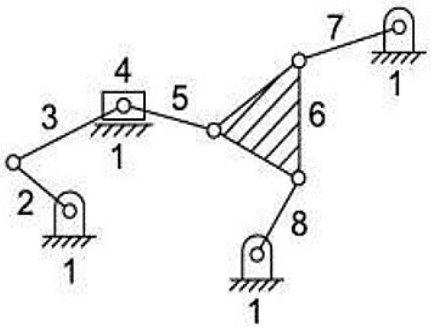
		CO	RBT LEVEL
1.	Consider a four-bar linkage system. The lengths of the links are as follows: Link 1 = 8 cm, Link 2 = 4 cm, Link 3 = 10 cm, and Link 4 = 6 cm. Determine whether the given system satisfies Grashof's criterion for at least one link to be capable of making a full revolution. Identify the link that can make a complete revolution.	**1**	**3**
2.	Mobility of a statically indeterminate structure is _____	**1**	**1**
3.	Differentiate complete and incomplete constraints in lower and higher pairs.	**1**	**2**
4.	The motion transmitted between the teeth of gears in mesh is: (a) sliding (b) rolling (c) may be rolling or sliding depending upon the shape of teeth (d) partly sliding and partly rolling	**1**	**1**
5.	What is velocity of rubbing?	**2**	**1**
6.	What are the types of mechanism synthesis?	**2**	**1**

7.	What is the difference between a linkage and a mechanism?	**2**	**1**
8.	What is Coriolis acceleration in shaper mechanism?	**2**	**1**
9.	Illustrate the term Workspace?	**3**	**1**
10.	State the three degrees of freedom associated with the arm and body motion?	**3**	**1**
11.	List the four basic robot configurations available commercially?	**3**	**1**
12.	Why is path planning required for a robotic system?	**3**	**2**
13.	State why Involute profile is preferred to cycloidal profile in Gear manufacturing.	**4**	**2**
14.	Differentiate double helical and herringbone gears?	**4**	**2**
15.	What are the special advantages of epicyclic gear trains ?	**4**	**1**
16.	When the axes of first and last gear are co-axial, then gear train is known as _____	**4**	**1**
17.	What affects the mechanical advantage in an inclined plane?	**5**	**2**
18.	Can friction be zero? Which friction is weaker?	**5**	**2**
19.	Which type of clutch has zero slip?	**5**	**2**
20.	Why do self-locking screws have less efficiency?	**5**	**2**

PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21. (a)	Determine the degree of freedom for the below mechanisms.	**(10)**	**1**	**3**

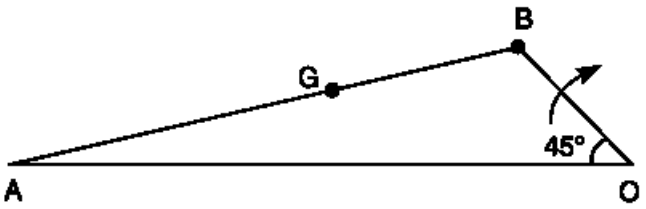




(OR)

(b)	Sketch sliders crank chain and its various inversions, stating actual machines in which these are used in practice.	**(10)**	**1**	**3**

22. (a)	The engine mechanism shown in Figure 22(a) has crank OB = 50 mm and length of connecting rod AB = 225 mm. The centre of gravity of the rod is at G which is 75 mm from B. The engine speed is 200 r.p.m. For the position shown, in which OB is turned 45° from OA, Find 1. the velocity of G and the angular velocity of AB.	**(10)**	**2**	**3**



(OR)

(b)	A four-bar mechanism is to be designed, by using three precision points, to generate the function $Y = X^{1.5}$, for the range $1 \leq x \leq 4$. Assuming 30° starting position and 120° finishing position for the input link and 90°starting position and 180° finishing position for the output link, find the values of x, y, θ and φ corresponding to the three precision points.	**(10)**	**2**	**3**

23. (a)	Classify and differentiate workspace configurations for a robot with neat diagrams and provide application for each configuration.	**(10)**	**3**	**3**

(OR)

(b)	Draw and establish a link coordinate system for a PUMA robot.	**(10)**	**3**	**3**

24. (a)	Two involute gears in a mesh have a module of 8 mm and a pressure angle of 20°. The larger gear has 57 while the pinion has 23 teeth. If the addenda on	**(10)**	**4**	**3**

pinion and gear wheels are equals to one module, find the length of path of contact, arc of contact and contact ratio.

(OR)

(b)	A cam operating a knife-edged follower has the following data: (a) Follower moves outwards through 40 mm during 60° of cam rotation. (b) Follower dwells for the next 45°. (c) Follower returns to its original position during the next 90°. (d) Follower dwells for the rest of the rotation. The displacement of the follower is to take place with Uniform Velocity during both the outward and return strokes. The least radius of the cam is 50 mm. Draw the profile of the cam when the axis of the follower passes through the cam axis.	**(10)**	**4**	**3**
25. (a)	A 150 mm diameter valve, against which a steam pressure of 2 MN/m^2 is acting, is closed by means of a square threaded screw 50 mm in external diameter with 6 mm pitch. If the coefficient of friction is 0.12; find the torque required to turn the handle.	**(10)**	**5**	**3**

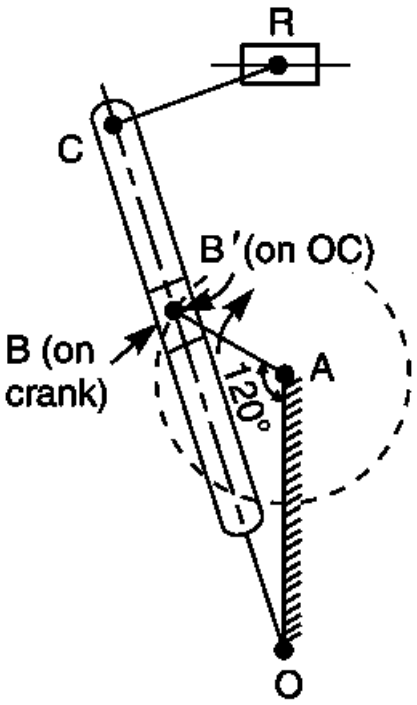
(OR)

(b)	A flat footstep bearing of 300 mm diameter supports a load of 8 kN. If the coefficient of friction is 0.10 and speed of the shaft is 80 rpm, find the power lost in friction, assuming (a) uniform pressure, and (b) uniform wear.	**(10)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26.	Figure shows the mechanism of a quick return motion of the crank and slotted lever type shaping machine. The dimensions of the various links are as follows: OA = 200 mm; A B = 100 mm; OC = 400 mm; and CR = 150 mm. The driving crank A B makes 120° with the vertical and rotates at 60 r.p.m. in the clockwise direction. Find: 1. velocity of ram R, and 2. Velocity of B' on OC.	**(10)**	3	**5**


R
C
B ′(on OC)
B (on crank)
120°
A
O

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