SE - IV - Mech - R-19 GP:- 20000298

Duration 3 hours **Maximum marks 80**

N.B: 1) Question No. 1 is **compulsory.**
2) Attempt any **three** questions out of remaining **five** questions
3) Assume suitable data wherever necessary but justify the same
4) Figures to the right indicate Marks

1. Answer any **four** of the following questions **20**

i) Classify Kinematic pairs with suitable example
ii) Classify different types of brakes with suitable example
iii) State and explain Kenedy theorem to locate ICR
iv) Derive the condition for correct steering in automobile
v) State and explain work energy principle and D'Alembert's principle

2. (A) A mechanism, as shown in Fig 1. has the following dimensions: A = 200 mm; AB = 1.5 m; BC = 600 mm; CD = 500 mm and BE = 400 mm. Locate all the instantaneous centres. If crank OA rotates uniformly at 120 r.p.m. clockwise, find 1. the velocity of B, and D. Locate at least 10 ICR **12**

Fig.1

(B) Differentiate with neat sketch Harts Mechanism and Peculiar Mechanism based on links/pair and application. **08**

3. **(A)** In the mechanism, as shown in Fig. 2 the crank OA rotates at 20 rpm anticlockwise and gives motion to the sliding blocks B and D. The dimensions of the various links are OA = 300 mm; AB = 1200 mm; BC = 450 mm and CD = 450 mm. For the given configuration, determine: 1. Velocities of sliding at B and D, 2. Angular velocity of CD, 3. linear acceleration of D. **14**

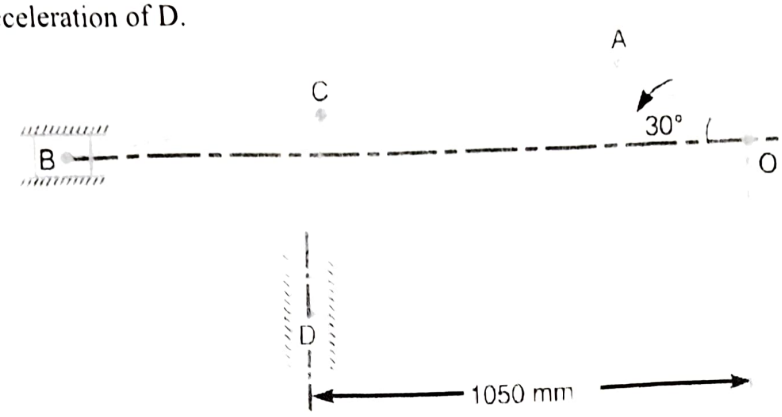


Fig 2

(B) What is Degree of Freedom (DOF) of plane mechanism with suitable example? Also compute degree of freedom for the mechanism shown. **06**

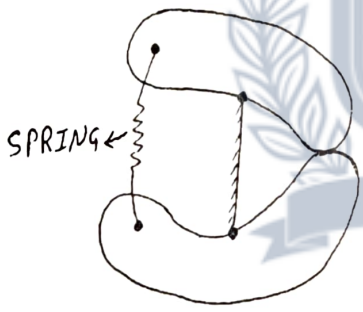


Fig 3

4. **(A)** A pump is driven by an electric motor through an open type of flat belt drive. Determine the belt specifications for the following data. (angle of lap, length of belt, ratio of tension, tension in each side, width of belt). Motor pulley diameter = 300 mm, Pump pulley diameter = 600 mm, Coefficient of friction = 0.25. Center distance between the pulleys = 1000 mm, Rotational speed of the motor =1440 rpm, Power transmission = 20kW; permissible tension = 10kN. **10**

(B) A uniform bar of mass 'm' and length 'L' hangs from a frictionless hinge. It is released from the horizontal position. Find the angular velocity of the centre of mass 'G' when it is vertical position. **10**

5. **(A)** An epicyclic gear consists of three gears A, B and C as shown in Fig. 4 The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 rpm. If the gear A is fixed, determine the speed of gears B and C. **10**

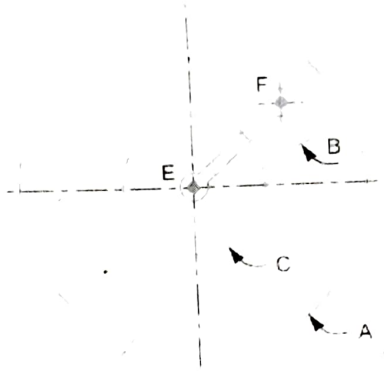


Fig 4

(B) Classify Cams and follower with suitable example. Also explain any Five Cam Terminology. **10**

6. **(A)** Two involute gears of 20° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module, Determine **10**
   1. The angle turned through by pinion when one pair of teeth is in mesh
   2. The maximum velocity of sliding

(B) A cam is rotating at 300 rpm operate a reciprocating knife edge follower. The least radius of cam is 30 mm, stroke of follower is 40 mm. Ascent takes place by uniform acceleration and deceleration and descent by simple harmonic motion. Ascent take place by 120° and descent during 90° of cam rotation. Dwell between ascent and descent 30°. Sketch displacement, velocity, and acceleration **10**

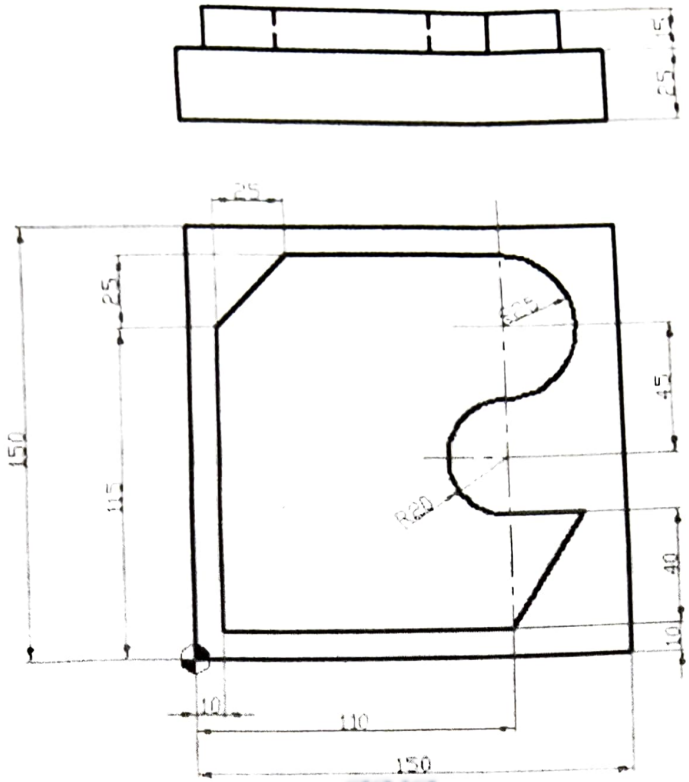
SE - IV - Mech - R-19 QP: - 20000129

Time : 3 Hours **Total Marks : 80**

- ***Question No.1 is compulsory.***
- *Solve **ANY THREE** questions from the **remaining five questions.***
- *The figure to the right indicates full marks.*
- *Assume suitable data wherever required.*

			Marks
Q. 1		Solve **ANY FOUR** questions from the following.	**20**
	a)	What are Bezier curves? Mention their applications.	**5**
	b)	Define homogeneous coordinates. Why are they used in transformations?	**5**
	c)	Differentiate between CT and MRI.	**5**
	d)	Define tool offset and workpiece zero setting.	**5**
	e)	Define Rapid Prototyping. Mention its benefits.	**5**
	f)	What are the benefits of virtual manufacturing.	
Q. 2	a)	Find the midpoint of the Bezier curve having end points $P_0(0,0)$ and $P_3(7,0)$ The other control points are $P_1(0,6)$ and $P_2(7,6)$.	**10**
	b)	A square with an edge length of 10 units is located on the origin with one of the edge at an angle of 30 degree with positive X-axis. Determine the new position of square, if it is rotated about Z-axis by an angle 30 degree in clockwise direction.	**10**
Q. 3	a)	Explain	
		i) Point Cloud data	**5**
		ii) Dicom	**5**
	b)	Explain wireframe, surface, and solid modeling approaches. Compare their advantages and limitations.	**10**
Q. 4	a)	Explain in brief the elements of CNC machine tool system. Write down advantages, limitations and applications of CNC machine tool system.	**10**
	b)	Explain the process of obtaining Cad solid model of body parts using CT output data.	**10**
Q. 5	a)	Discuss LOM (Laminated Object Manufacturing) with working, merits, and demerits.	**10**
	b)	Write a CNC part program for the following component :	**10**

SIGCE



Q. 6 a) Define Virtual Manufacturing and discuss its significance in the modern industrial landscape. What are the primary objectives and scope of Virtual Manufacturing? **10**

b) Describe the FDM process with a neat diagram and discuss applications. **10**

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SIGCE

SE-IV-Mech-R-19 qp:-10082459

Duration: 3 hours **Max Marks : 80**

N. B. : - 1) Question No 1 is compulsory.
2) Attempt any three questions out of the remaining five.
3) All questions carry equal marks.
4) Assume suitable data if required and state it clearly.

1 . Attempt any four. **[20]**

a) Draw and explain well labeled characteristics of BJT, IGBT and SCR .
b) Explain various features of logic family.
c) Explain the meaning of term commutation and suggest and explain any one method of forced commutation in SCR.
d) Compare De-Multiplexer and Multiplexer.
e) List the features of MSP430.

2 a) Explain the working of single phase Bridge inverter with R load. **[20]**

b) Explain various method of speed control of AC three phase induction motor.

3 a) Describe instrumentation amplifier with labeled diagram. State its application in various field **[20]**

b) Compare CMOS logic family with TTL logic family.

4 a) Explain need of digital to analog conversion. How the ADC in MSP430 works **[20]**

b) Explain BLDC motor. State its advantages.

5) a) Explain IC555 as timer . Write its application. **[20]**

b) Write difference between assembly programming and C language programming. Write various application of microcontroller and explain any one.

6) a) Describe speed torque characteristics of DC motor and AC motor. Explain their criteria For selection for industrial application. **[20]**

b) Draw and explain UJT as triggering method of SCR.

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SE - IV - Mech - R-19

QP: 10093866

Time: (3 Hours) **[Total Marks: 80]**

N.B.: 1) Question No. **1** is **Compulsory**.

2) Answer **any THREE** questions from Q.2 to Q.6.

3) Figures to the right indicate full marks.

Q.1 (a) Calculate Correlation coefficient between the variables x and y for the following data **(5)**

X	1	2	4	5	3
Y	3	3	5	8	6

(b) A random variable x has the following probability function **(5)**

X	1	2	3	4	5
P(x)	3c	2c	2c	c	2c

Find i) C ii) P(x<3) iii) E(X) iv) V(X)

(c) A random sample of 50 items gives the mean 6.2 and variance 10.24 .Can it be regarded as drawn from a normal population with mean 5.4 at 5% level of significance ? **(5)**

(d) Find a,b, and c if $\bar{F} = (x + 2y + az)i + (bx - 3y - z)j + (4x - cy + 2z)k$ is irrotational. **(5)**

Q.2 (a) Fit a straight line to the following data **(6)**

X	1	2	3	4	5
Y	5	8	3	9	6

(b) Find the work done in moving a particle in the force field $\bar{F} = (3x^2 + 6y)i - 14yzj + 20xz^2k$ along $x = t, y = t, z = t$ from $(0,0,0)$ to $(1,1,1)$. **(6)**

(c) Find all possible Laurent's series expansion of the function $f(z) = \frac{3}{(z+2)(z+5)}$ about $z = 0$ indicating region of convergence. **(8)**

Q.3 (a) Given: $2x + 6y = 90$, $9x + 3y = 130$ *are regression lines and* $\sigma_x^2 = 16$ then find (i) *mean of* X *and* Y (ii)*correlation coefficient* (r) $(iii)\sigma_y^2$ **(6)**

(b) Use Green's theorem to evaluate $\int_c (x^2 - y)\,dx + (2y^2 + x)dy$ where c is the boundary of the region enclosed by $y = x^2$ *and* $y = 4$. **(6)**

(c) Investigate the association between the darkness of eye colour in father and son from the following table using χ^2 -test (use 5% LOS) **(8)**

Colour of son's eyes	Colour of father's eyes			
		Dark	Not Dark	Total
	Dark	48	90	138
	Not Dark	80	782	862
	Total	128	872	1000

Q.4 (a) Let X be a continuous random variable with probability density function $f(x) = ke^{-x},\ x \geq 0$ Find k, mean and variance. **(6)**

(b) Following result were obtained from two samples each drawn from two different populations A and B **(6)**

Group	A	B
Sample Size	25	17
Sample SD	4	3

Test the hypothesis that variance of A is less than or equal to variance of B. Given $(F(0.05) = 2.24\ for d.o.f.\ 24\ and\ 16)$

(c) Show that $\bar{F} = (6xy + z^3)i + (3x^2 - z)j + (3xz^2 - y)k$ is conservative. **(8)**
Find scalar potential such that $\bar{F} = \nabla\emptyset$ and hence, find the work done by in displacing a particle from (1,2,0) to (3,3,2) .

Q.5 (a) A fair coin is tossed till a head appears. What is the expectation of the number of tosses required? **(6)**

(b) Using Stoke's Theorem to evaluate $\int_c \bar{F}.d\bar{r}$ where $\bar{F} = x^2i + xyj$ and c is the boundary of the rectangle $x = 0, y = 0, x = a, y = b$. **(6)**

(c) Evaluate $\int_c \frac{2z}{z^2-4} dz$ where c is (i) $|z - 2| = 1$ (ii) $|z + 2| = 1$. **(8)**

Q.6 (a) Four roads lead away from a jail. A prisoner trying to escape from the jail selected a road at random. If road A is selected, the probability of escaping is 1/8, for road B it is 1/6, for road C it is ¼ and for road D it is 9/10. What is the probability that a prisoner will succeed in escaping from the jail **(6)**

(b) Use Gauss Divergence theorem to evaluate $\iint_s \bar{F}.\hat{n}ds$ where **(6)**
$\bar{F} = 4x\hat{i} + 3y\hat{j} - 2z\hat{k}$ and s is the surface bounded by
$x = 0, y = 0, z = 0\ and\ 2x + 2y + z = 4$

(c) Monthly salary X in a big organization is normally distributed with mean Rs 3000 and standard deviation of Rs 250.What should be the minimum salary of a worker in this organization, so that the probability that he belongs to top 5% workers? **(8)**

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41222
SE Sem IV th R-19 C scheme Mechanical

(3 Hours) [Total Marks: 80]

N.B.: (1) **Question No.1 is Compulsory.**
(2) Attempt any three Questions out of remaining five questions.
(3) Figures to the right indicate full marks.
(4) Assume any suitable data if necessary and justify the same.

Q1 **Solve any FOUR**

A) Explain Classification of fluid flow 5

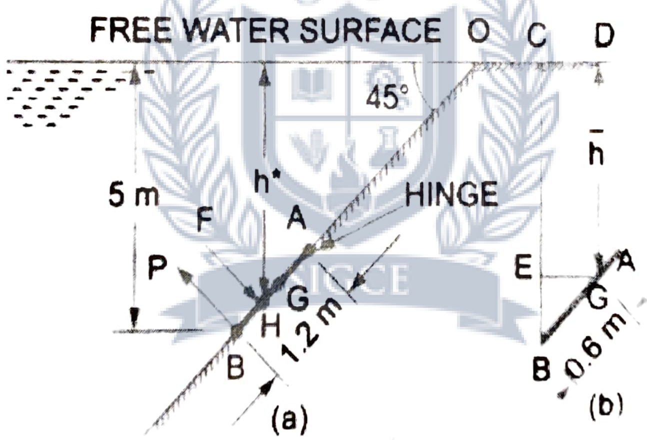
B) State and derive Hydrostatic law 5

C) Explain Orifice meter and Pitot tube in detail with neat sketch 5

D) A piston 9.95 cm in diameter works in a cylinder 10 cm diameter and 12 cm long. The space between the two is filled with an oil of viscosity 0.5 poise. Calculate the speed of the piston through the cylinder under the action of an axial force of 5 N. 5

E) Describe boundary layer separation and how to control boundary layer separation 5

Q2 A) An Inclined rectangular Sluice gate AB, 1.2m x 5 m size as shown in fig. is installed to control the discharge of water. The end A is hinged. Determine the force normal to the gate applied at B to open it. 10



B) Derive the Bernaulli's Theoram and state its assumption. 10

Q3 A) In a two dimensional incompressible flow, the fluid velocity components are given by **u = x - 4y** and **v = -y - 4x**. Show that velocity potential exists and determine its form. Find also the stream function. 10

B) Derive an expression for velocity distribution, discharge per unit width and shear stress when laminar flow between two parallel plates in which one plate moving and other at rest (Couette flow). 10

Q4 A) Using the laminar boundary velocity distribution: 10

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - 2\left(\frac{y}{\delta}\right)^3 + \left(\frac{y}{\delta}\right)^4$$

(i) Determine boundary layer thickness in terms of Re
(ii)Check if boundary layer separation occurs or not

B) Derive the Continuity equation in steady incompressible three dimensional flow 10

Q5 A) A 120° bend cum reducer has 300 mm diameter at inlet and 200 mm diameter at the outer end. When it carries a flow 0.3 m^3/s of water, the pressure at the inlet section is 210 kN/m^2. Assuming no energy loss in the bend determine the force exerted by the water on the bend. The bend is in a horizontal plane. 10

B) Crude oil of specific gravity 0.85 flow upwards at a volume rate of flow of 60 litre per second through a vertical Venturimeter with an inlet diameter of 200 mm and a throat diameter of 100 mm. The Cd is 0.98. The vertical distance between the pressure tapping is 300 mm. 10
(i) If two pressure gauges are connected at the tappings such that they are positioned at the levels of their corresponding tapping points, determine the difference of reading in N/cm^2 of the two pressure gauges.

Q6 A) Two pipes of diameters 50 cm and 25 cm are each 350 m long. What will be the loss of head when they are connected in series and carry a total discharge of 0.15 m^3/s? What will be the loss of head when same pipes are connected in parallel and carry same total discharge? Take coefficient of friction is 0.0075 for both pipes. Neglect minor losses. 10

B) **Solve any TWO** 10
(i) Explain various Major and Minor losses for flow through pipe?
(ii) Explain types of drag for flow around submerged objects.
(iii) Illustrate the difference between Buckingham π Theorem and Rayleigh's Method in dimensional analysis.

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ap code : 10085468

-SE sem IV Mechanical R-19 C scheme

Duration: 3hrs **[Max Marks:80]**

Shri. Indira Gandhi College of Engineering
19 MAY 2023
Navi Mumbai

N.B.: (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume any suitable data, wherever required, but justify the same. Assumptions made should be clearly stated.
(5) Illustrate the answers with sketches, wherever required.

1 Attempt any FOUR [20]

A Classify Kinematic pairs with suitable example [05]

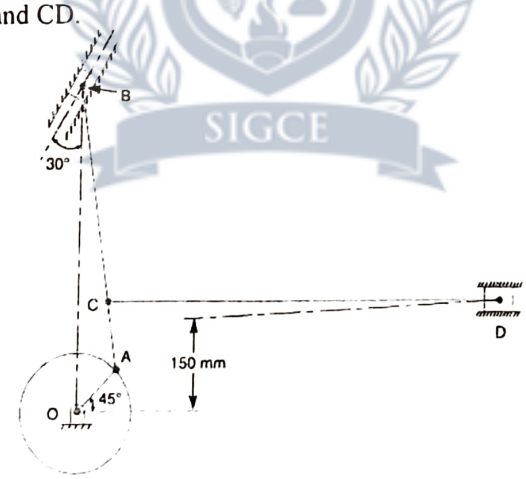
B Illustrate with neat sketch band brake and state its applications. [05]

C Classify gears with neat sketch and explain the law of gearing. [05]

D Differentiate between Involute and cycloidal gear tooth profile. [05]

E How Peaucellier's mechanism converts rotary motion into straight-line motion, explain in brief supported with a diagram. [05]

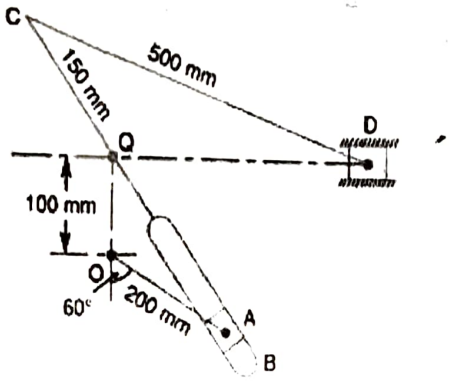
2 A The crank OA of a mechanism, as shown in Fig., rotates clockwise at 120 r.p.m. The lengths of various links are : OA = 100 mm ; AB = 500 mm ; AC = 100 mm and CD = 750 mm. Find, Velocity of point C ; Velocity of slider D ; and Angular velocities of the links AB and CD. [12]



B Explain the concept of centrifugal tension in case of belt drive and derive its equation and also state its effect on power transmission. [8]

3 A List the inversions of the single slider mechanism and explain the working of the oscillating cylinder engine mechanism. [8]

B A quick return motion mechanism in which the driving crank OA rotates at 120 r.p.m. in a clockwise direction. For the position shown in figure , determine the magnitude and direction of the acceleration of the block D ; and the angular acceleration of the slotted bar QB. [10]



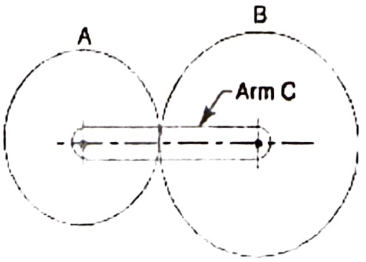
4 A A shaft rotating at 200 r.p.m. drives another shaft at 300 r.p.m. and transmits 6 kW through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4m. The smaller pulley is 0.5 m in diameter. Calculate the stress in the belt, if it is 1. an open belt drive, and 2. a cross belt drive. Take $\mu = 0.3$. [10]

B A pair of 20° full depth involute spur gears having 30 and 50 teeth respectively of module 4 mm are in mesh. The smaller gear rotates at 1000 r.p.m. Determine : 1. Sliding velocities at engagement and at disengagement of pair of a teeth, and 2. contact ratio. [10]

5 A A cam is rotating at 200 rpm operate a reciprocating roller follower of radius 2.5 cm. The least radius of cam is 30 mm, stroke of follower is 5 cm. Ascent takes place by uniform acceleration and deceleration and descent by simple harmonic motion. Ascent takes place by 70^0 and descent during 50^0 of cam rotation. Dwellbetween ascent and descent 60^0. Sketch displacement, velocity, acceleration. diagram. Indicate the maximum values of velocity and acceleration and state the nature of curve. [12]

B Obtain an expression for the length of a chain. [8]

6 A In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. 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 r.p.m. in the clockwise direction, what will be the speed of gear B. [10]



B Classify cams and follower and explain cam terminology. [10]

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QP code: 10082457

SE sem-IV Mechanical R-19 C scheme

Time: 3 hours **Max. Marks: 80**

Note: 1. Assume suitable data if necessary
2. Figures to the right indicate full marks
3. Question No. 1 is compulsory
4. Solve any **three** out of the remaining **five** questions

Smt. Indira Gandhi College of Engineering
23 MAY 2023
Navi Mumbai

Q1.	**Solve any four**	
A	Draw and explain labelled V-I characteristics of zener diode	5
B	List the important characteristic of comparator	5
C	Implement basic gate using NAND gate	5
D	Explain need of digital to analogue conversion	5
E	Draw and explain equivalent circuit of an OP-Amp	5
Q2.		
A	Classify types of loads on the basis of time duration	10
B	Explain in brief functional block diagram of MSP430	10
Q3.		
A	What do you understand by a Digital circuit? Explain following terms regarding digital circuit 1. Logic level 2. Nosie immunity 3. Propagation delay 4. Fan out	10
B	Explain in detail first order low pass active filter	10
Q4.		
A	Explain Positive and Negative feedback of Open loop configuration of an Op-Amp	10
B	Comparison of SCR and TRIAC	10
Q5.		
A	Explain single-phase bridge inverter operation with neat circuit diagram and waveforms	10
B	Explain construction and characteristics of power BJT	10
Q 6.		
A	Explain GTO. How does it differ from an SCR	10
B	Compare Monostable and Astable Multivibrators	10

SE Sem IV Mechanical R-19 C scheme ap code: 1008122

Duration: 3 Hours

N.B. (1) Question No.1 is Compulsory

(2) Attempt any three questions out of remaining five questions.

(3) Figures to the right indicate full marks.

(4) Assume suitable data, if required and state it clearly.

Max. Marks: 80

Indira Gandhi College of Engineering
12 MAY 2023
Navi Mumbai

Q. 1 Solve **ANY FOUR** [20]

a What is the significance of CAD/CAM in the product life cycle?

b What are 2D transformation matrices for i) Translation ii) Rotation iii) Scaling iv) Mirroring.

c List the advantages, disadvantages, and applications of MRI scan.

d Explain at least 5 Standard G and M codes need to be included in the beginning and ending of any general program.

e Explain basic steps in rapid prototyping process.

f Write short note on scope of Virtual Manufacturing.

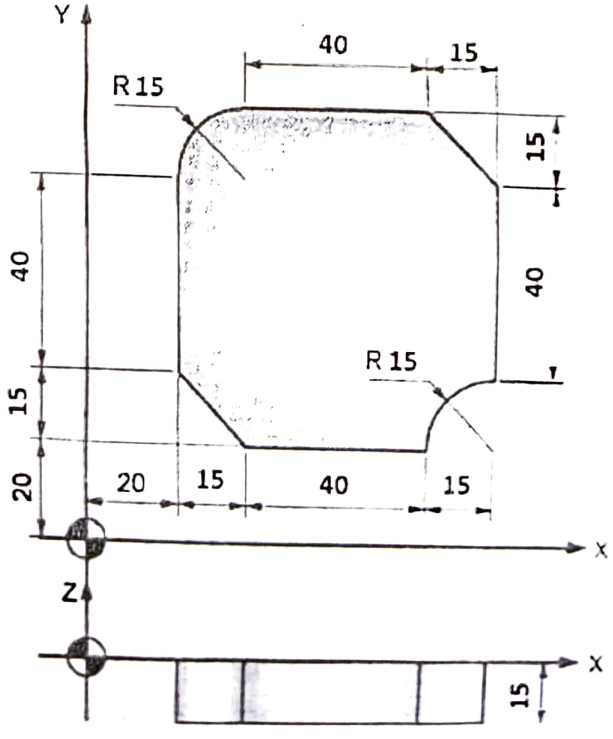
Q. 2 a Explain working principle, application, advantages & disadvantages of Stereolithography Apparatus (SLA) [10]

b A triangle PQR has its vertices P(0,0), Q(4,0) and R(2,3). It is translated by 4 units in X direction and 2 units in Y direction. It is then rotated by 90 degree in anticlockwise direction about the new position of point R. Find the vertices of the triangle. [10]

Q. 3 a i) Compare analytical and synthetic curves. [5]

ii) What are the applications of 3D solid CAD model. [5]

b Write a CNC part program using G and M codes for contouring a component as shown in following figure having thickness 15 mm. Assume suitable data if needed. [10]

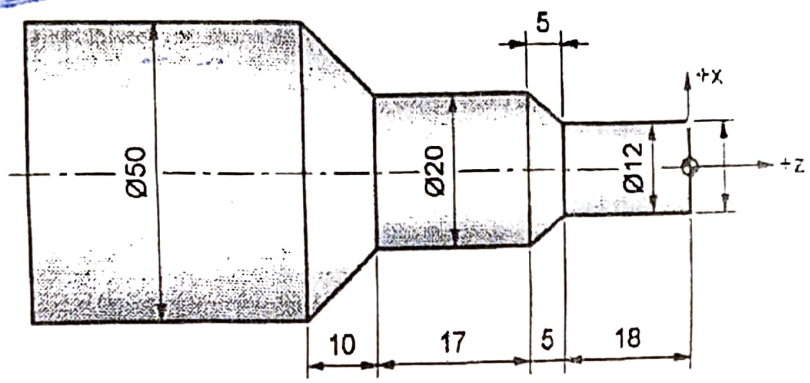


Q. 4 a Explain the significance of medical scan data in biomedical modeling. How are medical scan data acquired and processed for further analysis? [10]

b A Hermite cubic spline is defined by points (1,1) and (6,5), having tangent vectors as (0,4) and (4,0). Find the coordinates of the mid-point and slope at the same point. [10]

Q. 5 a Explain the working of Cone Beam CT with its advantages and disadvantages. [10]

b Write a manual part program for the finishing the following component as shown in figure. Illustrate the meaning of each code used in the program and the tool movement by showing the tool path. Assume suitable data if needed. [10]



Q. 6 a Compare SLA, SLS, 3D Printing, FDM, and LOM in terms of their working principles and capabilities. [10]

b Discuss the potential challenges and limitations of Virtual Manufacturing. [5]

c Explain the socio-economic aspects of Virtual Manufacturing. [5]

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QPcode: 10082313

SE Sem IV R-19 e Scheme Mechanical

(3 Hours) [Total Marks: 80]

N.B. : 1) Question No. **1** is **Compulsory**.
2) Answer **any THREE** questions from Q.2 to Q.6.
3) Figures to the right indicate full marks.

Q.1 (a) Fit a straight line to the following data **(5)**

X	1	2	3	4	5	6
Y	49	54	60	73	80	86

(b) Calculate Correlation coefficient between the variables x and y for the following data **(5)**

X	12	15	18	21	27
Y	2	4	6	8	12

(c) Let X be a continuous random variable with probability density function **(5)**

$f(x) = \frac{x}{6} + k,\ 0 \le x \le 3$ Find k and $(1 \le x \le 2)$.

(d) Find the line integral of $\bar{F} = x^2 i + xyj$ along line OP where, **(5)**

$O = (0,0)$ *and* $P = (1,1)$.

Q.2 (a) A random variable x has the following probability function **(6)**

X	-2	-1	0	1	2	3
P(x)	0.1	k	0.2	2k	0.3	3k

Find i) k ii) P(x > 2) iii) E(X)

(b) Prove that $\bar{F} = (x + 2y + az)i + (bx - 3y - z)j + (4x + cy + 2z)k$ is solenoidal and find the constants a,b,c if $\bar{F}$ is irrotational. **(6)**

(c) Evaluate $\int_c \frac{z+6}{z^2-4} dz$ where c is (i) $|z| = 1$ (ii) $|z-2| = 1$ (iii) $|z+2| = 1$. **(8)**

Q.3 (a) The average breaking strength of steel rods is specified to be 17.5 (in units of 1000 kg) to test this sample of 14 rods tested & gave the following results: 15, 18, 16, 21, 19, 21, 17, 17, 15, 17, 20, 19, 17, 18. Is the result of the experiment significant? **(6)**

(b) Use Green's theorem to evaluate $\int_c (2x^2 - y^2)\,dx + (x^2 + y^2)dy$ where c is the boundary of the region enclosed by the lines $x = 0, y = 0, x = 2, y = 2$. **(6)**

(c) If height of 500 students are normally distributed with mean 68 inches and standard deviation 4 inches, Find the number of students having heights (i) greater than 72 inches (ii) between 65 and 71 inches (iii) less than 62 inches. **(8)**

Q.4 **(a)** Use Gauss Divergence theorem to evaluate $\iint_s \bar{F}.\hat{n}ds$ where $\bar{F} = 4xz\hat{i} - y^2\hat{j} + yz\hat{k}$ and s is the surface of the cube bounded by $x = 0,\ x = 1,\ y = 0,\ y = 1, z = 0, z = 1.$ (6)

(b) Find the lines of regression for the following data to estimate y corresponding to $x = 155$ (6)

X	100	110	120	130	140	150	160	170	180	190
Y	45	51	54	61	66	70	74	78	85	89

(c) Find all possible Laurent's series expansion of the function $f(z) = \frac{5z+7}{(z+3)(z+2)}$ about $z = 0$ indicating region of convergence. (8)

Q.5 **(a)** The standard deviation from two random samples of sizes 9 and 13 are 1.99 and 1.9. Can the samples be regard as drawn from normal population with same standard deviation? $(F_{(8,12)}(0.025) = 3.51, F_{(12,8)}(0.025) = 4.20)$ (6)

(b) Using Stoke's Theorem to evaluate $\int_c \bar{F}.d\bar{r}$ where $\bar{F} = yi + zj + xk$ and c is the boundary of surface $x^2 + y^2 = 1 - z,\ z > 0.$ (6)

(c) In an experiment on immunization of cattle from tuberculosis the following results were obtained (use 5% LOS) (8)

	Affected	Not Affected	Total
Inoculated	267	27	294
Not Inoculated	757	155	912
Total	1024	182	1206

Use Chi Square test to determine the efficiency of vaccine in preventing tuberculosis.

Q.6 **(a)** A bag contains 7 red balls and 3 black balls and another bag contains 4 red balls and 5 black balls. One ball is transferred from the first bag to the second bag then a ball is drawn from the second bag. If this ball happens to be red, Use Bayes' theorem to find the probability that a black ball was transferred. (6)

(b) A car hire firm has 2 cars which it hires out day by day. The number of demands for a car on each day is distributed as Poisson variate with mean 1.5. Calculate the probability of days on which some demand is refused. (6)

(c) Show that $\bar{F} = (2xy + z)i + (x^2 + 2yz^3)j + (3y^2z^2 + x)k$ is conservative. Find scalar potential such that $\bar{F} = \nabla\emptyset$ and hence, find the work done by $\bar{F}$ in displacing a particle from (1,2,0) to (2,2,1). (8)

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 QPcode: 1008533

SE sem IV R-19 C scheme Mechanical

Time: 3 Hours **Total Marks: 80**

15 MAY 2025

N.B. : (1) **Question No. 1 is compulsory.**
(2) **Attempt any three questions out of remaining five questions.**
(3) **Figures to the right indicates full marks.**
(4) **Assume any suitable data if necessary and justify the same.**

Q.1 Solve any **FOUR**

A) Explain velocity potential and stream function. 5

B) Calculate the weight density, density and specific gravity of one litre of liquid which weighs 7N. 5

C) Define boundary layer and explain boundary layer formation. 5

D) State and prove Pascal's Law and give some application. 5

E) Write a short note on Reynold's experiment. 5

Q.2 A) The velocity vector in a fluid flow is given as $V = 4x^3i - 10x^2yj + 2tk$ Find the velocity and acceleration of a fluid particle at (2, 1, 3) at t = 1. 10

B) A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of oil of specific gravity 0.8. The discharge of oil through venturimeter is 60 litres/sec. Find the reading of oil mercury differential manometer. Take Cd = 0.98 10

Q.3 A) An oil of viscosity 0.1 Ns/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and a length 300 m. The rate of flow of fluid through the pipe is 3.5 litres/s. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall. 10

B) Derive Euler's equation of motion and from that derive Bernoulli's equation. 10

Q.4 A) The velocity distribution in boundary layer is given by, 10

$$\frac{u}{U} = \frac{3}{2}\frac{y}{\delta} - \frac{1}{2}\frac{y^2}{\delta^2}$$

Calculate the following
i) Displacement thickness ii) Momentum thickness iii) Energy thickness
iv) check whether the boundary layer separation occurs or not.

B) The resisting force F of a plane during flight can be considered as dependent upon the length of aircraft *l*, velocity υ, air viscosity μ, air density ρ. and bulk modulus of air K. Express the functional relationship between these variables and the resisting force using dimensional analysis. 10

Q.5 A) 360 litres per second of water is flowing in a pipe. The pipe is bent by 120°. The pipe bend measures 360 mm × 240 mm and volume of the bend is 0.14 m^3. The pressure at the entrance is 73 kN/m^2 and the exit is 2.4 m above the entrance section. Find the force exerted on the bend. 10

B) Derive an expression for velocity distribution, discharge per unit width and shear stress when laminar flow between two parallel fixed plate. 10

Q.6 A) A horizontal pipeline 40 m long is connected to a water tank at 1 end, and discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter, and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the center of the pipe. Considering all losses of head which occurs, determine the rate of low. Take f = 0.01 for both sections of the pipe. 10

B) Write a short note on **(any two)** 10
i) Newtonion and Non-Newtonion Fluids.
ii) Streamline and Bluff bodies.
iii) Importance of Reynold's transport theorem

SIGCE

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 ap code: 10081222

SE sem IV Mechanical R-19 C scheme

Duration: 3 Hours **Max. Marks: 80**

N.B (1) **Question No.1 is Compulsory**
(2) **Attempt any three questions out of remaining five questions.**
(3) **Figures to the right indicate full marks.**
(4) **Assume suitable data, if required and state it clearly.**

Smt. Indira Gandhi College of Engineering
21 MAY 2025
Navi Mumbai

Q. 1 Solve **ANY FOUR** **[20]**

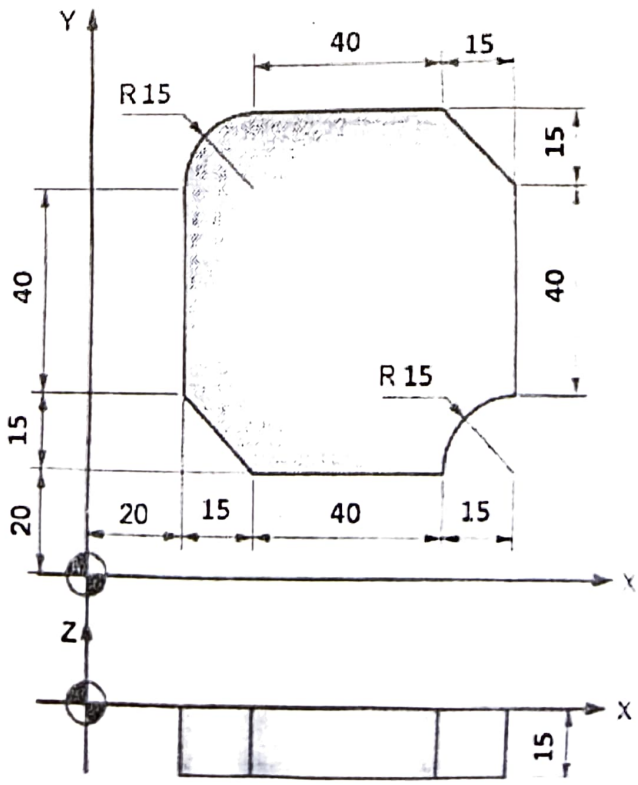
a What is the significance of CAD/CAM in the product life cycle?
b What are 2D transformation matrices for i) Translation ii) Rotation iii) Scaling iv) Mirroring.
c List the advantages, disadvantages, and applications of MRI scan.
d Explain at least 5 Standard G and M codes need to be included in the beginning and ending of any general program.
e Explain basic steps in rapid prototyping process.
f Write short note on scope of Virtual Manufacturing.

Q. 2 a Explain working principle, application, advantages & disadvantages of Stereolithography Apparatus (SLA) **[10]**

b A triangle PQR has its vertices P(0,0), Q(4,0) and R(2,3). It is translated by 4 units in X direction and 2 units in Y direction. It is then rotated by 90 degree in anticlockwise direction about the new position of point R. Find the vertices of the triangle. **[10]**

Q. 3 a i) Compare analytical and synthetic curves. **[5]**
ii) What are the applications of 3D solid CAD model. **[5]**

b. Write a CNC part program using G and M codes for contouring a component as shown in following figure having thickness 15 mm. Assume suitable data if needed. **[10]**

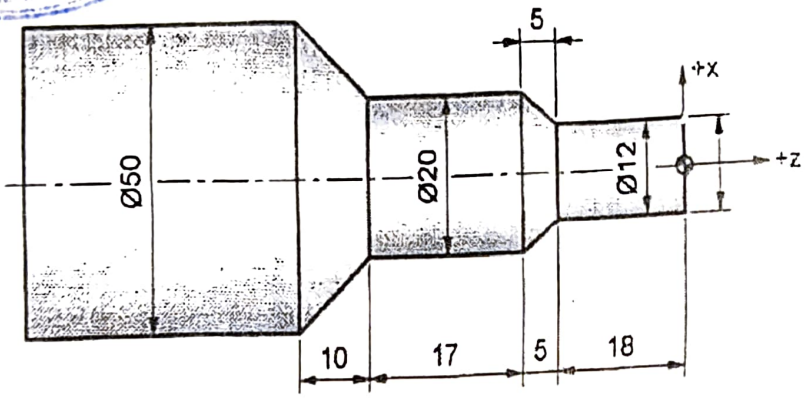


Q. 4 a Explain the significance of medical scan data in biomedical modeling. How are medical scan data acquired and processed for further analysis? [10]

b A Hermite cubic spline is defined by points (1,1) and (6,5), having tangent vectors as (0,4) and (4,0). Find the coordinates of the mid-point and slope at the same point. [10]

Q. 5 a Explain the working of Cone Beam CT with its advantages and disadvantages. [10]

b Write a manual part program for the finishing the following component as shown in figure. Illustrate the meaning of each code used in the program and the tool movement by showing the tool path. Assume suitable data if needed. [10]



Q. 6 a Compare SLA, SLS, 3D Printing, FDM, and LOM in terms of their working principles and capabilities. [10]

b Discuss the potential challenges and limitations of Virtual Manufacturing. [5]

c Explain the socio-economic aspects of Virtual Manufacturing. [5]

SIGCE

SE - IV - Mech - R-19

qp: 10093866

Time: (3 Hours)

[Total Marks: 80]

N.B.: 1) Question No. **1** is **Compulsory**.

2) Answer **any THREE** questions from Q.2 to Q.6.

3) Figures to the right indicate full marks.

Q.1 (a) Calculate Correlation coefficient between the variables x and y for the following data **(5)**

X	1	2	4	5	3
Y	3	3	5	8	6

(b) A random variable x has the following probability function **(5)**

X	1	2	3	4	5
P(x)	3c	2c	2c	c	2c

Find i) C ii) P(x<3) iii) E(X) iv) V(X)

(c) A random sample of 50 items gives the mean 6.2 and variance 10.24 .Can it be regarded as drawn from a normal population with mean 5.4 at 5% level of significance ? **(5)**

(d) Find a,b, and c if $\bar{F} = (x + 2y + az)i + (bx - 3y - z)j + (4x - cy + 2z)k$ is irrotational. **(5)**

Q.2 (a) Fit a straight line to the following data **(6)**

X	1	2	3	4	5
Y	5	8	3	9	6

(b) Find the work done in moving a particle in the force field $\bar{F} = (3x^2 + 6y)i - 14yzj + 20xz^2k$ along $x = t, y = t, z = t$ from $(0,0,0)$ *to* $(1,1,1)$. **(6)**

(c) Find all possible Laurent's series expansion of the function $f(z) = \frac{3}{(z+2)(z+5)}$ about $z = 0$ indicating region of convergence. **(8)**

Q.3 (a) Given: $2x + 6y = 90$, $9x + 3y = 130$ *are regression lines and* $\sigma_x^2 = 16$ then find (i) *mean of* X *and* Y (ii)*correlation coefficient* (r) $(iii)\sigma_y^2$ **(6)**

(b) Use Green's theorem to evaluate $\int_c (x^2 - y)\,dx + (2y^2 + x)dy$ where c is the boundary of the region enclosed by $y = x^2$ *and* $y = 4$. **(6)**

(c) Investigate the association between the darkness of eye colour in father and son from the following table using χ^2 -test (use 5% LOS) **(8)**

Colour of son's eyes	Colour of father's eyes		
	Dark	Not Dark	Total
Dark	48	90	138
Not Dark	80	782	862
Total	128	872	1000

Q.4 (a) Let X be a continuous random variable with probability density function $f(x) = ke^{-x},\ x \geq 0$ Find k, mean and variance. **(6)**

(b) Following result were obtained from two samples each drawn from two different populations A and B **(6)**

Group	A	B
Sample Size	25	17
Sample SD	4	3

Test the hypothesis that variance of A is less than or equal to variance of B. Given $(F(0.05) = 2.24\ ford.o.f.24\ and\ 16)$

(c) Show that $\bar{F} = (6xy + z^3)i + (3x^2 - z)j + (3xz^2 - y)k$ is conservative. **(8)**
Find scalar potential such that $\bar{F} = \nabla\emptyset$ and hence, find the work done by in displacing a particle from (1,2,0) to (3,3,2) .

Q.5 (a) A fair coin is tossed till a head appears. What is the expectation of the number of tosses required? **(6)**

(b) Using Stoke's Theorem to evaluate $\int_c \bar{F}.d\bar{r}$ where $\bar{F} = x^2i + xyj$ and c is the boundary of the rectangle $x = 0, y = 0, x = a, y = b$. **(6)**

(c) Evaluate $\int_c \frac{2z}{z^2-4} dz$ where c is (i) $|z-2| = 1$ (ii) $|z+2| = 1$. **(8)**

Q.6 (a) Four roads lead away from a jail. A prisoner trying to escape from the jail selected a road at random. If road A is selected, the probability of escaping is 1/8. for road B it is 1/6. for road C it is ¼ and for road D it is 9/10. What is the probability that a prisoner will succeed in escaping from the jail **(6)**

(b) Use Gauss Divergence theorem to evaluate $\iint_s \bar{F}.\hat{n}ds$ where **(6)**
$\bar{F} = 4x\hat{i} + 3y\hat{j} - 2z\hat{k}$ and s is the surface bounded by
$x = 0, y = 0, z = 0\ and\ 2x + 2y + z = 4$

(c) Monthly salary X in a big organization is normally distributed with mean Rs 3000 and standard deviation of Rs 250.What should be the minimum salary of a worker in this organization, so that the probability that he belongs to top 5% workers? **(8)**

SE - IV - Mech - R-19 gp:- 20000298

Duration 3 hours **Maximum marks 80**

N.B: 1) Question No. 1 is **compulsory.**
2) Attempt any **three** questions out of remaining **five** questions
3) Assume suitable data wherever necessary but justify the same
4) Figures to the right indicate Marks

1. Answer any **four** of the following questions **20**

i) Classify Kinematic pairs with suitable example
ii) Classify different types of brakes with suitable example
iii) State and explain Kenedy theorem to locate ICR
iv) Derive the condition for correct steering in automobile
v) State and explain work energy principle and D'Alembert's principle

2. (A) A mechanism, as shown in Fig 1. has the following dimensions: A = 200 mm; AB = 1.5 m; BC = 600 mm; CD = 500 mm and BE = 400 mm. Locate all the instantaneous centres. If crank OA rotates uniformly at 120 r.p.m. clockwise, find 1. the velocity of B, and D. Locate at least 10 ICR **12**

Fig.1

(B) Differentiate with neat sketch Harts Mechanism and Peculiar Mechanism based on links/pair and application. **08**

3. **(A)** In the mechanism, as shown in Fig. 2 the crank OA rotates at 20 rpm anticlockwise and gives motion to the sliding blocks B and D. The dimensions of the various links are OA = 300 mm; AB = 1200 mm; BC = 450 mm and CD = 450 mm. For the given configuration, determine: 1. Velocities of sliding at B and D, 2. Angular velocity of CD, 3. linear acceleration of D. **14**

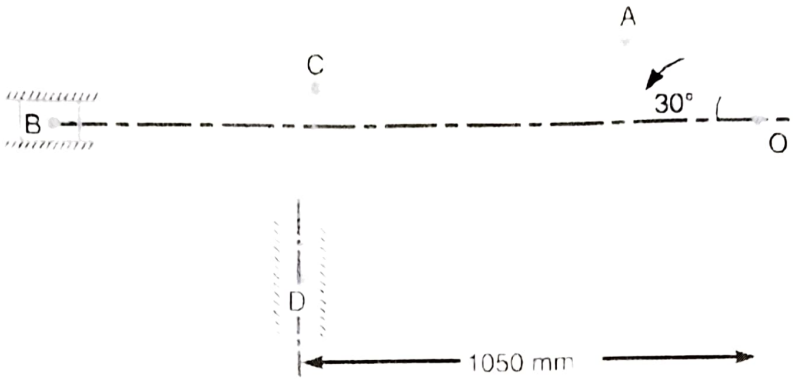


Fig 2

(B) What is Degree of Freedom (DOF) of plane mechanism with suitable example? Also compute degree of freedom for the mechanism shown. **06**

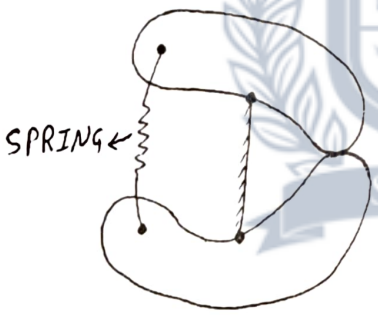


Fig 3

4. **(A)** A pump is driven by an electric motor through an open type of flat belt drive. Determine the belt specifications for the following data. (angle of lap, length of belt, ratio of tension, tension in each side, width of belt). Motor pulley diameter = 300 mm, Pump pulley diameter = 600 mm, Coefficient of friction = 0.25. Center distance between the pulleys = 1000 mm, Rotational speed of the motor =1440 rpm, Power transmission = 20kW; permissible tension = 10kN. **10**

(B) A uniform bar of mass 'm' and length 'L' hangs from a frictionless hinge. It is released from the horizontal position. Find the angular velocity of the centre of mass 'G' when it is vertical position. **10**

5. **(A)** An epicyclic gear consists of three gears A, B and C as shown in Fig. 4 The gear A has 72 internal teeth and gear C has 32 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 18 rpm. If the gear A is fixed, determine the speed of gears B and C. **10**

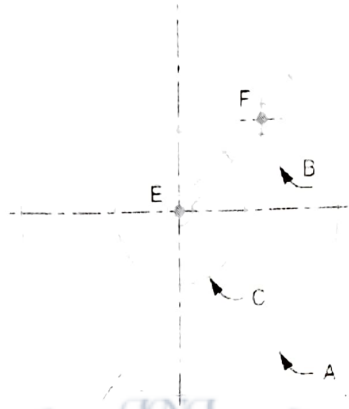


Fig 4

(B) Classify Cams and follower with suitable example. Also explain any Five Cam Terminology. **10**

6. **(A)** Two involute gears of 20° pressure angle are in mesh. The number of teeth on pinion is 20 and the gear ratio is 2. If the pitch expressed in module is 5 mm and the pitch line speed is 1.2 m/s, assuming addendum as standard and equal to one module, Determine **10**

1. The angle turned through by pinion when one pair of teeth is in mesh
2. The maximum velocity of sliding

(B) A cam is rotating at 300 rpm operate a reciprocating knife edge follower. The least radius of cam is 30 mm, stroke of follower is 40 mm. Ascent takes place by uniform acceleration and deceleration and descent by simple harmonic motion. Ascent take place by 120° and descent during 90° of cam rotation. Dwell between ascent and descent 30°. Sketch displacement, velocity, and acceleration **10**