**Duration: 3hrs**   **[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   What are the applications of 3D solid CAD model.
   b   Determine the coordinate of a 3D point P (5, 7, 9) when rotated by 30 degree in CCW
       direction about Z axis.
   c   Explain the use of RP in biomedical field.
   d   Briefly explain the elements of NC Machine Tool System with neat sketch.
   e   Compare Bezier Curve and B-Spline Curve.

2 a   A cubic Bezier curve is defined by the control points as (20,20), (60,80),   **[10]**
           (120,100) and (150, 30). Find the equation of the curve and its midpoint.
   b   Explain Fused Deposition modelling with its advantages, disadvantages and   **[10]**
       applications.

3 a   A triangle PQR with vertices P (2,5), Q (6,7) and R (2,7) is to be reflected about   **[10]**
           the line y=0. 5x+3.Determine (i) the concatenated transformation matrix and (ii)
           co-ordinates of the vertices for the reflected triangle.
   b   Explain the major steps involved in rapid prototyping, list the various rapid   **[10]**
       prototyping techniques and explain any one of them with neat sketch in brief.

4 a   Explain in brief the elements of CNC machine tool system. Write down   **[10]**
           advantages, limitations and applications of CNC machine tool system.
   b   Write short note on 3D printing with neat sketch.   **[10]**

5 a   Write complete part programing for the forged component shown in following   **[10]**
           figure by taking finishing cut of 1 mm.
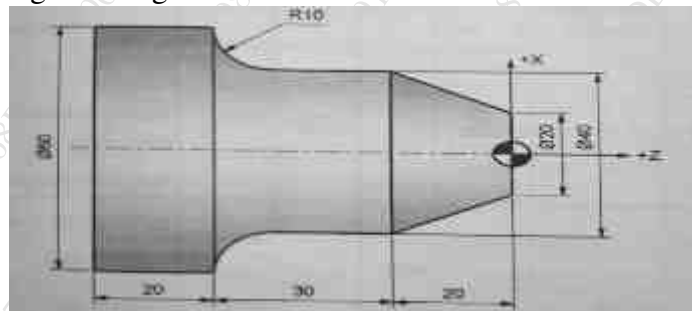
   b   Explain the process of obtaining CAD solid model of body parts using CT output   **[10]**
       data.

6 a   Explain in brief Augmented Reality (AR) and Virtual Reality (VR).   **[10]**
   b   Explain the concept of homogeneous co-ordinate system and its significance.   **[10]**

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(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) Evaluate $\int_0^{1+i}(y + ix^2)\, dz$ along the parabola $y = x^2$.   (5)

(b) $If\ \overline{F} = (x + 2y + az)i + (bx - 3y - z)j + (4x + cy + 2z)k$ is   (5)
irrotational then find the values of a, b, c

(c) A continuous random variable has pdf $f(x) = ke^{-x}, 0 \le x < \infty$.   (5)
Determine k, mean, variance.

(d)   (5)

x	3	5	4	6	2
y	3	4	5	2	6

Calculate the Karl Pearson's coefficient of correlation .

Q.2 (a) The following are the marks scored by students in two tests in a subject.   (6)
Calculate Spearman's rank correlation coefficient of from the following
data.

Marks in Test 1	18	20	34	52	12
Marks in Test 2	39	23	35	18	46

   (6)

(b) Find the MGF of a random variable X whose p.m.f is given by

x	0	1	2	3
P(x)	1/18	1/9	5/18	10/18

. Hence find mean and Variance of X.

(c) Obtain all possible Laurent's series expansion of   (8)
$f(z) = \frac{z}{(z-1)(z-2)}$ about $z = 0$.

Q.3 (a) Three urns are there containing white and black balls; first urn has 3 white   (6)
and 2 black balls, second urn has 2 white and 3 black balls and third urn
has 4 white and 1 black balls. Without any biasing one urn is chosen from
that one ball is chosen randomly which was white. What is probability
that it came from the third urn?

(b) Fit the second degree polynomial for following data   (6)

X	1	2	3	4	5	6	7
Y	-5	-2	5	16	31	50	73

(c) Prove that $\overline{F} = (2xy + z)i + (x^2 + 2yz^3)j + (3y^2z^2 + x)k$ is   (8)
conservative. Find scalar potential of $\overline{F}$. Hence find the work done of
moving particle from (1,2,0) to (2,2,1).

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Q.4 (a) Using Green's Theorem evaluate $\int_c (x^2 - y)dx + (y^2 + x)dy$ and c (6)
is closed curve of the region bounded by $y = 4$ and $y = x^2$.

(b) Samples of two types of electric bulbs were tested for length of life (6)
and following data were obtained

	Type I	Type II
Number of samples	8	7
Mean of samples(in hour)	1134	1024
Standard Deviation(in hour)	35	40

Test at 5% level of significance whether the difference in the sample
means is significant.

(c) In a normal Distribution, 30% of students scored below 35 and 10% (8)
scored above 60. Find the mean and standard deviation.

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

(b) Use Gauss's Divergence Theorem to evaluate $\iint_s \overline{N}.\overline{F}\ ds$, where (6)
$\overline{F} = 4xi - 2y^2j + z^2k$ and S is region bounded by $x^2 + y^2 = 4, z = 0, z = 4$.

(c) Obtain both Line of regressions for the data given below (8)

X	65	66	67	67	68	69	70	72
Y	67	68	65	68	72	72	69	71

Also find X for Y = 70.

Q.6 (a) Evaluate $\int_c \frac{z+3}{(2z^2+3z-2)}dz$, where c is the circle |z-i|=2. (6)

(b) The following data relate to marks obtained by 11 students in 2 tests, (6)
one held at the beginning of the year and the other at the end of the
year after intensive coaching:

Test 1	19	23	16	24	17	18	20	18	21	19	20
Test 2	17	24	20	24	20	22	20	20	18	22	19

(c) The following table gives the number of accidents in a district during (8)
a week. Apply χ^2 test to find whether the accidents are uniformly
distributed over the week.

Day	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
No. of days	13	12	11	9	15	10	14

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`Duration: 3hrs**   [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 A 120 mm disc rotates on a table separated by an oil film of 1.8 mm thickness. Find the   **[5]**
      viscosity of oil if the torque required to rotate the disc at 60 r.p.m is 3.6×10^{-4} Nm. Assume
      the velocity gradient in the oil film to be linear.

  b Explain Lagrangian and Eulerian method of representing fluid flow.   **[5]**

  c A 3 m long wooden stick of cross section area 0.01 m^2 is made to float vertically in water   **[5]**
      with 0.6 m length above the water surface by attaching a lead piece at the lower end of
      the stick. Find out the weight of the lead piece to be attached if the specific weight of
      wood is 6 kN/m^3 and that of lead is 120 kN/m^3

  d Explain Hydraulic gradient line and Energy gradient line in detail.   **[5]**
  e Define drag and lift and explain types of drag.   **[5]**

2 **a** Does the velocity potential exist for two dimensional, incompressible flow prescribed by   **[10]**
      u = x – 4y and v = - (y + 4x)? If so, determine its form as well as that of stream function.

  b A cylindrical gate of 4 m diameter 2 m long has water on its both sides. Determine the   **[10]**
      magnitude and direction of the resultant force exerted by the water on the gate.

3 **a** The pressure difference Δp in a pipe of diameter D and length *l* due to viscous flow   **[10]**
      depends on the velocity V, viscosity μ and density ρ. Using Buckingham's π-theorem,
      obtain the expression for Δp.

  b The diameter of a pipe bend 30 cm at inlet and 15 cm at outlet and flow is turned through   **[10]**
      120º (angle measured in clockwise direction between direction of fluid flow at inlet and
      outlet) in a vertical plane. The axis at inlet is horizontal and the centre of the outlet section
      is 1.5 m below the centre of inlet section. Total volume of water in the bend is 0.9 m^3.
      Neglecting friction, calculate the magnitude and direction of force exerted on the bend by
      water flowing through it at 250 lit/s and when inlet pressure is 0.15 N/mm^2.

4 **a** An oil of viscosity 1 poise and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and of length 300 m. The rate of fluid through the pipe is 3.5 litres/s. Find
(i) Is the flow laminar?
(ii) the pressure drop in a length of 300 m
(iii) shear stress at the pipe wall **[10]**

b Derive Reynold's transport theorem **[10]**

5 **a** Derive the expression for velocity distribution, discharge per unit width and shear stress distribution when flow of viscous fluid between two parallel plates in which one plate moving and other at rest. **[10]**

b A venturimeter is to be fitted in a pipe 0.25 m diameter where the pressure head is 7.6 m of flowing liquid and the maximum flow is 8.1 m^3 per minute. Find the least diameter of the throat to ensure that the pressure head does not become negative. Take $C_d = 0.96$ **[10]**

6 **a** Three pipes with details as following are connected in parallel between two points. **[10]**
Pipe 1 : length = 1000 m   diameter = 20 cm   coefficient of friction $f = 0.02$
Pipe 2 : length = 1200 m   diameter = 30 cm   coefficient of friction $f = 0.015$
Pipe 3 : length = 800 m   diameter = 15 cm   coefficient of friction $f = 0.02$
When the total discharge of 0.30 m^3/sec flows through the system, calculate distribution of discharge and head loss between the junctions.

b The velocity distribution in the boundary layer is given by **[10]**
$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$
Calculate the following
(i) Displacement thickness (ii) Momentum thickness (iii) Energy thickness
(iv) Check whether the boundary layer separation occurs or not

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Duration: 3hrs   **[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 characteristics of power BJT, power MOSFET & IGBT	
	b	Explain equivalent circuit of an OP-AMP.	
	c	Implement basic gates using NAND gate.	
	d	List the features of MSP 430.	
	e	Compare AC and DC motors.	
2	a	What is GTO? Explain switching characteristics of GTO.	**[10]**
	b	Explain BLDC motor. State its advantages.	**[10]**
3	a	Draw and explain Astable mode of operation of IC 555.	**[10]**
	b	Explain the different peripherals of MSP430 microcontroller.	**[10]**
4	a	Compare CMOS logic family with TTL logic family.	**[10]**
	b	Draw and explain single phase full wave fully controlled rectifier with the help of waveforms for R load.	**[10]**
5	a	Explain the application of piezo-electric actuator drive.	**[10]**
	b	Draw and explain the circuit diagram and waveforms of single-phase bridge inverter with R load.	**[10]**
6	a	Explain instrumentation amplifier. State its advantages and disadvantages.	**[10]**
	b	Draw and explain UJT triggering method of SCR.	**[10]**

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Time: 3 Hrs   **Marks : 80**

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 and explain different types of instantaneous centres?

   ii)   With neat sketch explain Undercutting in CAMS

   iii) Explain slip and creep in belt drives.

   iv)   Classify Kinematic pairs with suitable example?

   v)   State and explain work energy principle

2. (A) The mechanism, as shown in Fig. 1 the slider D is constrained to move on a   **12**
         horizontal path. The crank OA is rotating in the counter clockwise direction at a
         speed of 180 r.p.m. The dimensions of various links are as follows: OA = 180
         mm; CB= 240 mm; AB = 360 mm; and BD = 540 mm. For the given
         configuration, find:
         Velocity of slider D,
         1. By instantaneous center method
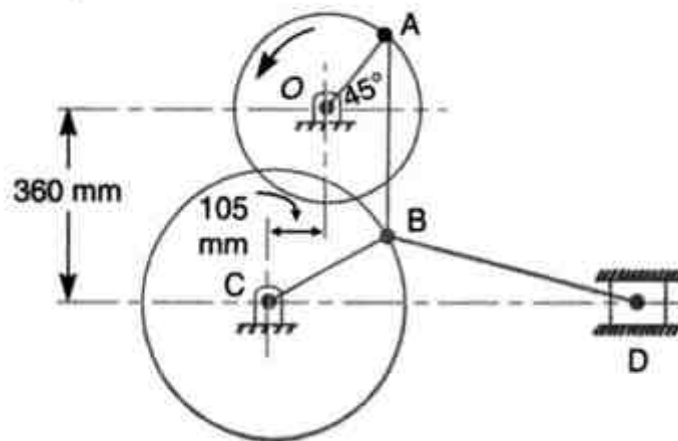   2. By relative velocity method

Fig. 1

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(B) Draw a neat sketch of Harts mechanism and prove that it traces a exact straight **08**
line.

3. (A) Fia 2 shows the mechanism of a radial valve gear. The crank OA turns uniformly **14**
at 150 rpm and is pinned at A to rod AB. The point C in the rod is guided in the
circular path with D as center and DC as radius. The dimensions of various links
are OA = 150 mm; AB = 550 mm; AC = 450 mm; DC = 500 mm; BE = 350 mm.
Determine velocity and acceleration of the ram F for the given position of the
mechanism.
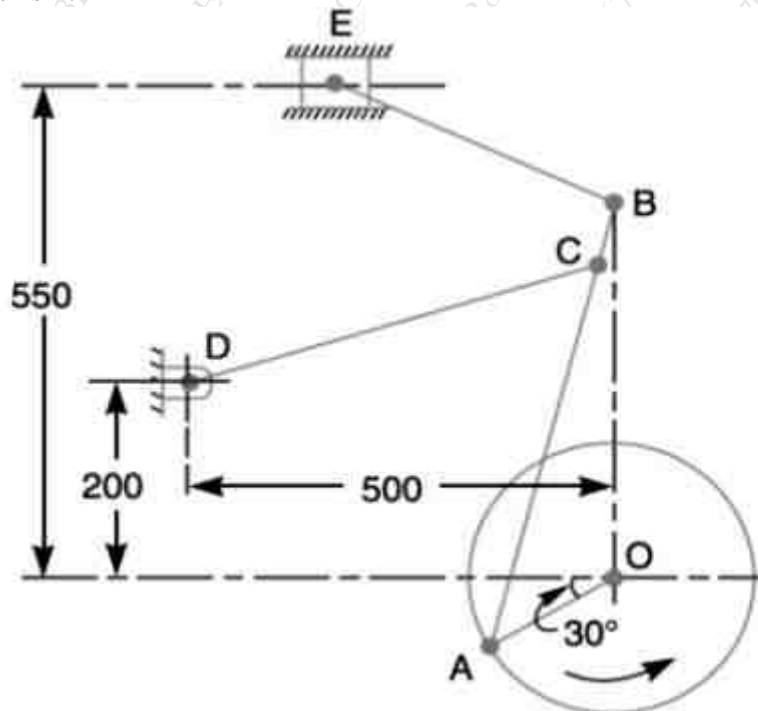
Fig. 2

(B) Determine the maximum permissible angle between the shaft axes of a universal **06**
joint if the driving shaft rotates at 800 rpm and the total fluctuation of the speed
does not exceeds 60 rpm. Also compute maximum and minimum speeds of driven
shafts.

4. (A) In an open belt drive, the diameters of the larger and smaller pulley are 1.2 m and **10**
0.8 m respectively. The smaller pulley rotates at 320 rpm. The center distance
between the shafts is 4 m. When stationary, the initial tension on the belt is 2.8
kN. The mass of belt is 1.8 kg/m and the coefficient of friction between the belt
and pulley is 0.25. Determine the power transmitted.

(B) A cord wrapped around a solid cylinder of radius 'r' and mass 'm'. The cylinder is **10**
released from rest. Determine the velocity of its centre of mass after it has moved
down a distance 'h'.

5. (A) Fig 3 shows a reverted epicyclic gear train, the arm A carries two gears B and C **10** and a compound gear D – E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed, and the arm A makes 100 r.p.m. clockwise
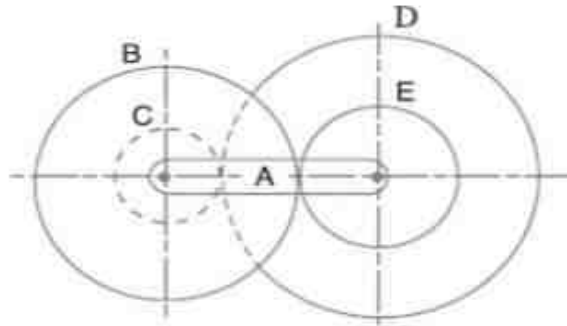

Fig. 3

(B) Illustrate with neat sketch band brake and state its applications. **05**

(C) Explain the concept of centrifugal tension and sate its effect on power transmission ? **05**

6. (A) The number of teeth on each of the two equal spur gears in mesh is 50. The teeth **08** have 20° involute profile and the module is 6 mm. If the arc of contact is 1.65 times the circular pitch. Find the addendum.

(B) A cam is rotating at 200 rpm operate a reciprocating roller follower of radius 2.5 **12** 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° and descent during 50° of cam rotation. Dwell between ascent and descent 60°. Sketch displacement, velocity, acceleration, diagram. Indicate the maximum values of velocity and acceleration and state the nature of curves.

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