**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	Write short note on scope of Virtual Manufacturing	[5]
	b	Write short note on Homogeneous Coordinate system	[5]
	c	Explain translation, scaling, rotation and reflection with suitable examples	[5]
	d	Briefly explain the elements of NC Machine Tool System with neat sketch.	[5]
	e	What are the applications of 3D solid CAD model?	[5]

2   a   Write the complete manual part program using Gand M codes to machine the   [10]
outline of geometry for the part as shown in figure. The thickness of the plate is
3mm thick. The end mill is 10mm in diameter. Assume suitable speed and feed
for machining parameters.
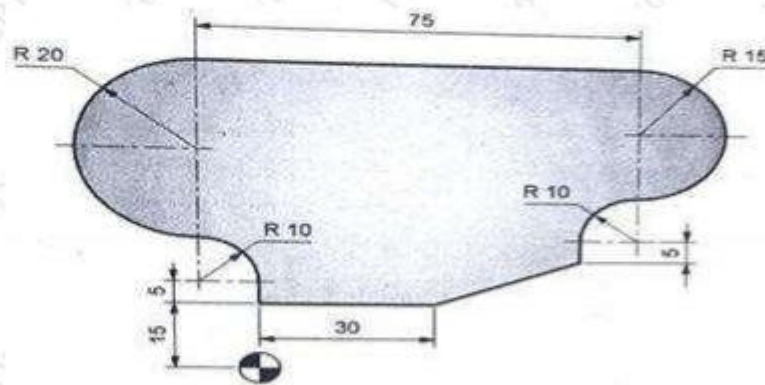
b   A Triangle ABC having vertices A (10,5), B(20,15) and C (25,30) is rotated by   [10]
40 degree CCW about a point P (5, 5). Determine the composite transformation
matrix and the new coordinate of the triangle.

3   A   A triangle PQR with vertices P (2, 2), Q (5, 2) and R (4, 7) is to be reflected   [10]
about the line y=0. 5x+3.Determine (i) the concatenated transformation matrix
and (ii) co- ordinates of the vertices for the reflected triangle.

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b Write a manual part program for the finishing of a forged component as shown [10] in the figure. Assume the speed and feed on the turning center are 400rpm and 0.35mm/revolution respectively. Assume 1mm material is to be removed radially from the external diameter.

Fig.
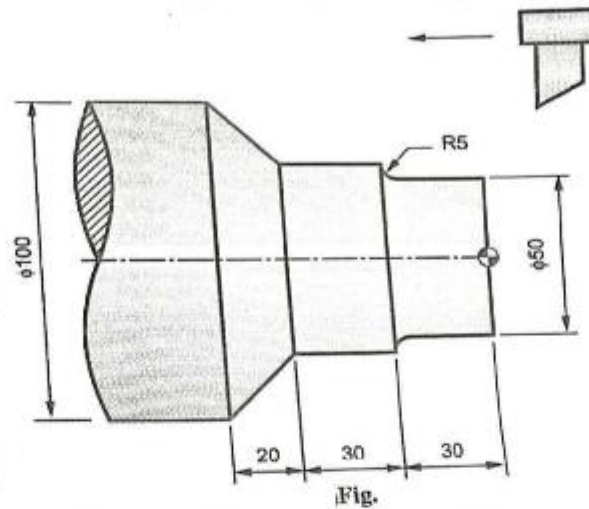
4 a Explain the characteristics of the Bezier curve and plot a Bezier curve having [10] control points as P_0 (1, 2), P_1 (3, 4), P_2 (6, -6) and P_3 (10, 8). Take a step size of 0.1. Mid-point.

b Explain Selective Laser Sintering in detail with neat and clean diagram [10]

5 a a. Explain in brief Augmented Reality (AR) and Virtual Reality (VR). [10]
b Write difference between Wireframe, Solid and surface Modeling

b The hermit cubic spline curve has the endpoints P_0 (1, 1) and P_1 (7, 4). The [10] tangent vector for the endpoint P_0 is defined by the line between P_0 and another point P_2 (8, 7) whereas the tangent vector for the endpoint P_1 is defined by the line between P_1 and point P_2 (8, 7). Plot the curve for the points at the values of u=0, 0.2, 0.4, 0.6, 0.8, and 1.0.

6 a Explain turning canned cycle with a suitable example [05]

b Write a short note on tool length compensation [05]

c Write a short note on scope of CAD CAM in product life cycle. [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)** Calculate Correlation coefficient between the variables x and y for the following (5)
data

X	18	20	34	52	12
Y	39	23	35	18	46

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

X	0	1	2	3	4	5
P(x)	0	C	2C	2C	3C	2C

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

(c) The mean life time of a sample of 25 bulbs is found as 1550 hours with standard (5)
deviation of 120 hours. The company manufacturing the bulbs claims that the
average life of their bulbs is 1600 hours. Is the claim acceptable at 5% LOS?

(d) Prove that $\bar{F} = (x + 2y + 4z)i + (2x - 3y - z)j + (4x - y + 2z)k$ is solenoidal (5)
and irrotational.

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

X	1	2	3	4	5
Y	25	28	33	39	46

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

(c) Find all possible Laurent's series expansion of the function $f(z) = \frac{z-1}{(z+1)(z-3)}$ (8)
about $z = 0$ indicating region of convergence.

Q.3 **(a)** The regression lines of a sample are x + 6y = 6 and 3x + 2y =10 Find (a) $\bar{x}$ and $\bar{y}$ (6)
(b) correlation coefficient r. Also estimate y when x =12.

(b) Use Green's theorem to evaluate $\int_c (3x^2 - 8y^2)\,dx + (4y - 6xy)dy$ where c (6)
is the boundary of the region enclosed by the lines $x = 0, y = 0, x + y = 1$.

(c) A certain drug is claimed to be effective in curing cold in an experiment on 500 (8)
persons with cold. 300 of them were given drug and 200 of them were given the
sugar pills. The patients reaction to the treatment are recorded in the following
table using χ^2 -test (use 5% LOS)

	Helped	Harmed	No Effect	Total
Drug	200	40	60	300
Sugar pills	120	30	50	200
Total	320	70	110	500

Test the hypothesis that the drug is effective in curing cold.

Q.4 **(a)** Let X be a continuous random variable with probability density function **(6)**
$f(x) = k(x - x^2)$, $0 \le x \le 1$ Find k, mean and variance.

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

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)** If X denotes the outcome when a fair die is tossed, find MGF of X about **(6)**
origin and hence find the mean of X.

(b) Using Stoke's Theorem to evaluate $\int_c \bar{F}.d\bar{r}$ where $\bar{F} = (x^2 - y^2)i +$ **(6)**
$2xyj$ and c is the boundary of $x = 0, y = 0, x = 4, y = 2$.

(c) Evaluate $\int_c \frac{z^2+3}{z^2-1} dz$ where c is (i) $|z - 1| = 1$ (ii) $|z + 1| = 1$. **(8)**

Q.6 **(a)** Three factories A, B, C produce 30%, 50% & 20% of the total production **(6)**
of an item .Out of their production 80%, 50% & 10% are defective. An
item is chosen at random and found to be defective. Using Bayes theorem
find the probability that it was produced by the factory A.

(b) Use Gauss Divergence theorem to evaluate $\iint_s \bar{F}.\hat{n} ds$ where **(6)**
$\bar{F} = x^3\hat{i} + y^3\hat{j} + z^3\hat{k}$ and s is the surface of the sphere $x^2 + y^2 + z^2 = 1$

(c) In an intelligence test administered to 1000 students, the average was 42 **(8)**
and standard deviation was 24. Find the number of students (i) exceeding
the score 50 (ii) between 30 and 54 (iii) less than 30.

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(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 Streamlined and bluff bodies   **5**

B) Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm^2 **5**
(gauge) and mean velocity of 2.0 m/s. find the total head or total energy per unit
weight of the water at a cross section, which is 5m above the datum line.

C) Explain Velocity Potential and Stream Function   **5**

D) Explain major and minor losses in pipes   **5**

E) One litre of crude oil weighs 9.6 N. Calculate its specific weight, density and   **5**
specific gravity?

Q2 A) Derive Euler equation of motion along a streamline and from that derive   **10**
Bernoulli's theorem.

B) The curved face of a dam is shaped according to the relation $y = \frac{x^2}{12.25}$ as shown   **10**
in fig. If the width of the dam is unity and height of water retained by the dam is
12 m. determine the magnitude and direction of the resultant water pressure
acting on the curved face of the dam.
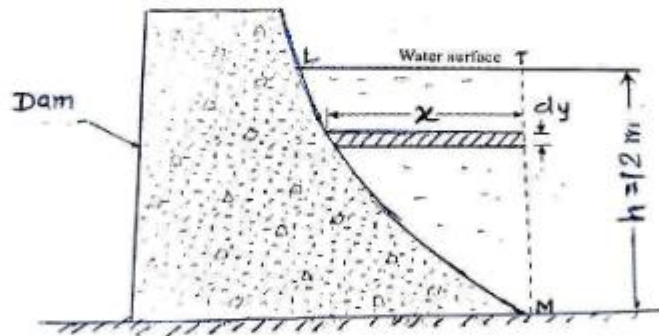
Q3 A) A 0.4m x 0.3m, 90° vertical reducing bend carries 0.5 m^3/s oil of specific gravity   **10**
0.85 with a pressure of 118 KN/m^2 at inlet to the bend. The volume of bend is 0.1
m^3. Find the magnitude and direction of the force on the bend. Neglect the
frictional losses and assume both inlet and outlet sections to be at same horizontal
level. Also assume that water enters the bend at 45° to the horizontal.

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

Q4 A) Using the laminar boundary layer velocity distribution: **10**

$$\frac{u}{U_\infty} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$$

i) Check if boundary layer separation occurs.
ii) Determine Boundary layer thickness (In terms of Re)

B) Derive the expression for the total pressure force and Centre of pressure when   **10**
Vertical surface submerge in liquid.

Q5 A) A partially submerged body is towed in water. The resistance R to its motion   **10**
depend on the density ρ, the viscosity μ of water, length of the body, velocity V
of the body and acceleration due to gravity. Show that the resistance to motion can
be expressed in the form

$$R = \rho L^2 V^2 \phi\left[\left(\frac{\mu}{\rho LV}\right), \left(\frac{Lg}{V^2}\right)\right]$$

B) The flow field of a fluid is given by V = xyi + 2yzj − (yz + z²)k   **10**
(i) Show that it represent a possible three- dimensional steady incompressible
continuous flow.
(ii) Is this flow rotational or irrotational?
   If rotational, determine at point A (2, 4, 6)
(a) Angular Velocity
(b) Vorticity
(c) shear strains

Q6 A) Two reservoirs are connected by three pipes in series.   **10**

Pipe	Length	Diameter	Coefficient of friction
1	300 m	30 cm	0.02
2	250 m	25cm	0.025
3	200 m	20cm	0.03

Calculate the discharge through them if the elevation difference of the levels is in
the reservoirs is 20 m. consider the minor losses.

B) Write short notes (**any TWO**)   **10**

   I.   Classification of fluid flow
   II.   Importance of Reynolds Transport theorem (RTT).
   III. With neat sketch explain any two application of Bernoulli's theorem

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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 labeled characteristics of BJT, IGBT and SCR.

   b) Describe logic level, noise and immunity for digital circuits.

   c) Explain the working of single phase bridge inverter with R load.

   d) Compare inverting and non-inverting amplifier with suitable examples.

   e) List any five features of MSP430 microcontroller.

2   a) Explain the term commutation and explain any one method of

      SCR turning on and turning off using suitable diagram.   [10]

   b) Using block diagram, describe the speed control of AC three phase motor.   [10]

3 a) Describe working of an instrumentation amplifier with labeled diagram. State any

     two applications.   [10]

   b) Compare CMOS logic family with TTL logic family using any five points.   [10]

4 a) Explain the need of digital to analog conversion. How does ADC system work in

     MSP430 microcontroller ?   [10]

   b) Explain basic construction and working of BLDC motor. State four advantages of

     BLDC motor over conventional motors.

5) a) Explain the working of IC555 as timer. Enlist its two applications.   [10]

   b) i) Write difference between assembly programming and C language programming.

     ii) Enlist any four microcontroller applications.   [10]

6) a) Describe speed torque characteristics of DC motor and AC motor. Explain their

     selection criteria for industrial application.   [10]

   b) Draw and explain UJT as triggering circuit for SCR as semiconductor switch.   [10]

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Max marks 80   **Duration: 3Hours**

N.B:

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

Q 1 Solve any four   [20]

1. State and Explain Dalembert's Principle
2. Explain Hooks joint with neat sketch
3. Differentiate between involutes and cycloidal gear tooth profile
4. Classify various types of chains
5. Sketch, explain reverted gear train with suitable example
6. Types of ICR

Q 2 A) In the mechanism, as shown in Fig 1. the crank OA rotates at 20 r.p.m. anticlockwise and gives motion to the sliding blocks B and D. The dimensions of the various inks are OA = 300 mm; AB = 1200 mm; BC = 450 mm and CD = 450 mm. Compute acceleration of slider B and D.   [14]
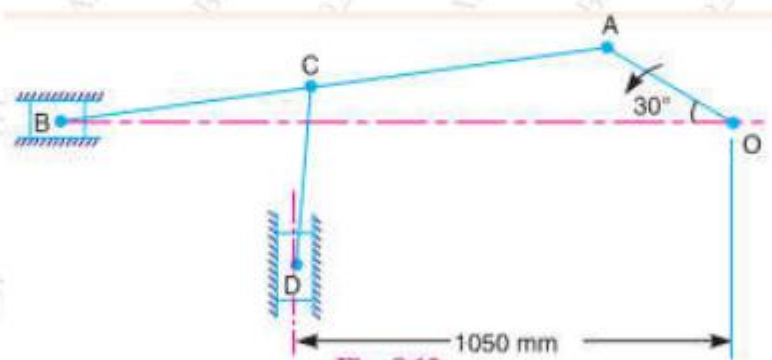

Fig 1

Q 2 B) Explain with neat sketch Corolies component of acceleration.   [6]

Q 3 A) A flat belt drives a pulley, the angle of the lap being 120°. The belt is 100 mm wide and 6 mm thick. The density of belt material is 1000 kg/m³. If the coefficient of friction is 0.3 and the maximum stress in the belt should not exceed 2 MPa, find the maximum power that the belt can transmit and the corresponding speed of the belt.   [10]

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Q 3 B) A sphere of radius 0.1m starts rolling without slip up on an inclined plane. The angle of plane is 30° with the horizontal. If the initial angular velocity of the sphere is 5 rad/sec, determine how far the sphere will travel before it reverse its motion. **[10]**

Q 4 A) Derive the equation for correct steering in Davis steering mechanism. **[10]**

Q 4 B) Derive the equation for ratio of tension for flat belt drive. **[10]**

Q 5 A) Classify gear and gear trains with neat sketch. Also state law of gearing. **[10]**

Q 5 B) Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth are of involute form; module = 5 mm, addendum = one module, pressure angle = 20°. The pinion rotates at 150 r.p.m. Determine: 1. The number of teeth on the pinion to avoid interference on it and the corresponding number of teeth on the wheel, 2. The length of path and arc of contact, 3. The number of pairs of teeth in contact, and 4. The maximum velocity of sliding.**[10]**

6. (A) Classify cams and follower and explain cam terminology **[8]**

   (B) A cam is rotating at 300 rpm operate a reciprocating knife edge follower. The least radius of cam is 25 mm, stroke of follower is 35 mm. Ascent and descent by simple harmonic motion. Ascent takes place by 60° and descent during 45° of cam rotation. Dwell between ascent and descent 30°. Sketch displacement, velocity, and acceleration. State the nature of curves and show the maximum values of velocity and acceleration. **[12]**