

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 IC 555 as Monostable Multivibrator.
 - b Explain the High pass active filter.
 - c Explain various features of logic family.
 - d Explain commutation and suggest with circuit diagram any natural commutation method of SCR.
 - e Compare De multiplexer and Multiplexer.
- 2 a Explain an ac to DC controlled converter supplying resistive load. Derive an expression for calculating output dc voltage. [10]
- b Describe instrumentation amplifier with labeled diagram. State its application area. [10]
- 3 a Explain the necessity of closed loop speed control in DC motor. [10]
- b Draw Differentiator ,integrator circuit with output voltage equation. [10]
- 4 a Explain need of digital to analogue conversion. How the ADC in MSP430 works? [10]
- b Explain three phase inverter operation with waveforms. [10]
- 5 a Draw and explain important sections of MSP 430 microcontroller. [10]
- b Compare digital circuits with Analog circuit. List Application of Each of them. [10]
- 6 a Describe speed torque characteristics of DC and AC motors. [10]
- b Compare microprocessor and microcontroller. [10]

(3 Hours)

[Total Marks: 80]

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 (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 methods to control boundary layer separation **5**
- B)** Derive an expression for theoretical Discharge through venturimeter with neat sketch. **5**
- C)** Explain in detail the classification of fluid flow **5**
- D)** Explain the Archimedes principle and condition of Stability of Submerged body **5**
- E)** Define the following properties of fluid : **5**
 (i) Specific weight (ii) Specific Gravity (iii) Viscosity (iv) Surface tension
 (v) Capillarity
- Q2** **A)** Derive the expression for the total pressure force and centre of pressure an inclined surface submerge in liquid. **10**
- B)** The velocity components in a two-dimensional flow are $u = 2xy$ and $v = a^2 + x^2 - y^2$ determine (i) Stream function (ii) Velocity Potential function **10**
- Q3** **A)** 250 lit/sec of water is flowing in a pipe having diameter of 300 mm if the pipe is bend by 135° , Find the magnitude and direction of the resultant of the force. The pressure flowing is 39.24 N/cm^2 . **10**
- B)** Prove this relation $u = U_{max} \left[1 - \left(\frac{r}{R} \right)^2 \right]$ for the velocity distribution for laminar flow through a circular pipes. **10**
- Q4** **A)** Using the laminar boundary layer velocity distribution: **10**
- $$\frac{u}{U_\infty} = 2 \left(\frac{y}{\delta} \right) - 2 \left(\frac{y}{\delta} \right)^3 + \left(\frac{y}{\delta} \right)^4$$
- i) Check if boundary layer separation occurs.
 ii) Determine Boundary layer thickness (In terms of Re)
- B)** State and derive the Bernoulli's theorem and also state the assumptions made in the derivation of Bernoulli's Equation. **10**

- Q5 A)** Force acting on the propeller of an air craft depend upon the variables , V , ρ , μ , D and N **10**
, Deduce the formula for this force, based on Rayleigh 's method
- B)** An oil of density 917 kg/m^3 is being pumped in a 15 cm diameter pipe. The discharge is measured as 850 lit/min. The drop in pressure in a stretch of 800m of pipeline, both ends which are at the same elevation, is measured as 95 kPa. Estimate the absolute viscosity of the oil. **10**
- Q6 A)** Two reservoirs whose water levels differ by 20 m are connected with a compound pipeline consisting of three pipes in series. Pipes of 200 mm diameter is connected to upper reservoir and pipe of 300 mm diameter is connected to lower reservoir. Middle pipe is 150 mm diameter. All pipes are 100 m long with friction factor 0.023, 0.024 and 0.025 respectively. Consider all losses find rate of flow of water and velocity in each pipe. **10**
- B)** Write short notes (any TWO) **10**
- 1) Reynolds experiment
 - 2) Orificemeter and Pitot tube.
 - 3) Drag and lift on an aerofoil.

(3 Hours)

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

(b) Find k and mean of following distribution (5)

X	8	12	16	20	24
P(X=x)	1/8	k	3/8	1/4	1/12

(c) Evaluate $\int_c z dz$ where c is unit circle $|z| = 1$ (5)

(d) Show that $\underline{F} = (y^2 - z^2 + 3yz - 2x)i + (3xz + 2xy)j + (3xy - 2xz + 2z)k$ is both solenoidal and irrotational. (5)

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

(b) Fit a straight line for following data (6)

x	0	1	2	3	4
y	1	1.8	3.3	4.5	6.3

(c) Given $\underline{F} = (2xy + z)i + (x^2 + 2yz^3)j + (3y^2z^2 + x)k$, (8)

(a) Prove that \underline{F} is conservative.

(b) Find Scalar potential function ϕ such that $\underline{F} = \nabla\phi$.

(c) Find the work done by \underline{F} in moving a particle from $A(1, 2, 0)$ to $B(2,2,1)$ along the straight line AB.

Q.3 (a) Two different processes A and B are used to manufacture tubes. Samples were drawn from these two populations and following results were obtained (6)

Population	A	B
Sample Size	25	17
Sample SD	4	3

Test the hypothesis that variance of A lesser than variance of B.

Given $(F_{(24,16)}(0.05) = 2.24)$

(b) An I.Q. test was administered to 5 persons and after they were trained. The results are given below. Test whether there is any change in I.Q. after the training program, use 1% LOS. (6)

	I	II	III	IV	V
I.Q. Before training	110	120	123	132	125
I.Q. after training	120	118	125	136	121

(c) Find the Laurent's series for $f(z) = \frac{2z-3}{(z-1)(z-3)}$ about $z = 0$. (8)

- Q.4** (a) Using Green's Theorem evaluate $\int_c (xy + y^2)dx + x^2dy$ and c is closed curve of the region bounded by $y = x$ and $y = x^2$. (6)
- (b) Find the probability that at most 4 defective bulbs will be found in a box of 200 bulbs if it is known that 2% of the bulbs are defective. (6)
- (c) The following table gives the number of accidents in a district during a week. Apply χ^2 test to find whether the accidents are uniformly distributed over the week. (8)

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

- Q.5** (a) Three factories A, B, C produce 30%, 50% and 20% of the total production of an item. Out of their production 80%, 50% and 10% are defective respectively. An item is chosen at random and found to be defective. Find the probability that it was produced by the factory A. (6)
- (b) A continuous random variable has pdf $f(x) = k(x - x^2), 0 \leq x \leq 1$. Determine k, mean, $P(0.5 \leq x \leq 3)$. (6)
- (c) The mean height of 500 students is 68 inches and the standard deviation is 4 inches. Assuming that the heights are normally distributed, find the number of students whose heights i) between 65 and 71 inches, ii) less than 62 inches, iii) greater than 72 inches. (8)

- Q.6** (a) Calculate Karl Pearson's coefficient of correlation from the following data. (6)

Price (in \$)	5	6	3	4	3
Demand (in units)	10	10	12	11	12

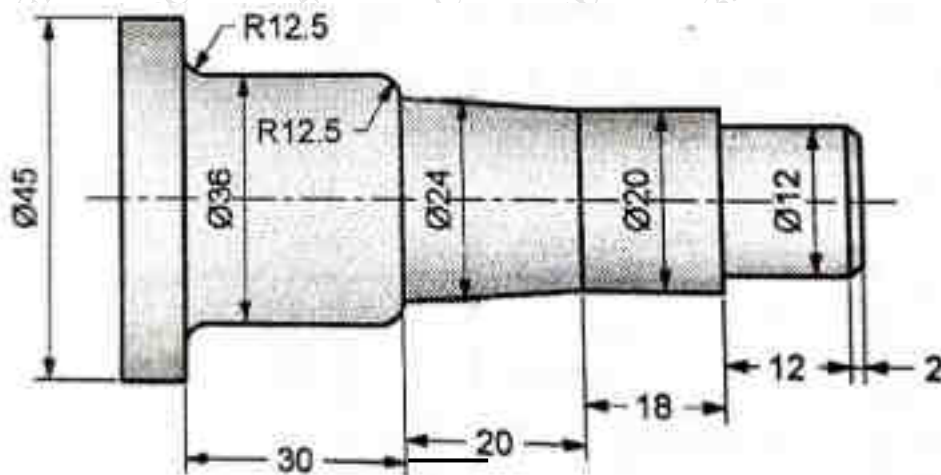
- (b) Use Divergence theorem to evaluate $\int \int_s \vec{F} \cdot \vec{ds}$ where $\vec{F} = 4x\hat{i} - 2y^2\hat{j} + z^2\hat{k}$ and s is the surface of the region $x^2 + y^2 = 4, z = 3$ above xy plane. (6)
- (c) The regression line of samples are $6y - 5x = 90$ & $15x - 8y = 130, \sigma_x = 4$ find i) Sample mean \bar{x}, \bar{y} ii) Coefficient of correlation between x & y iii) σ_y iv) Also estimate y at $x=10$. (8)

Duration: 3 Hours

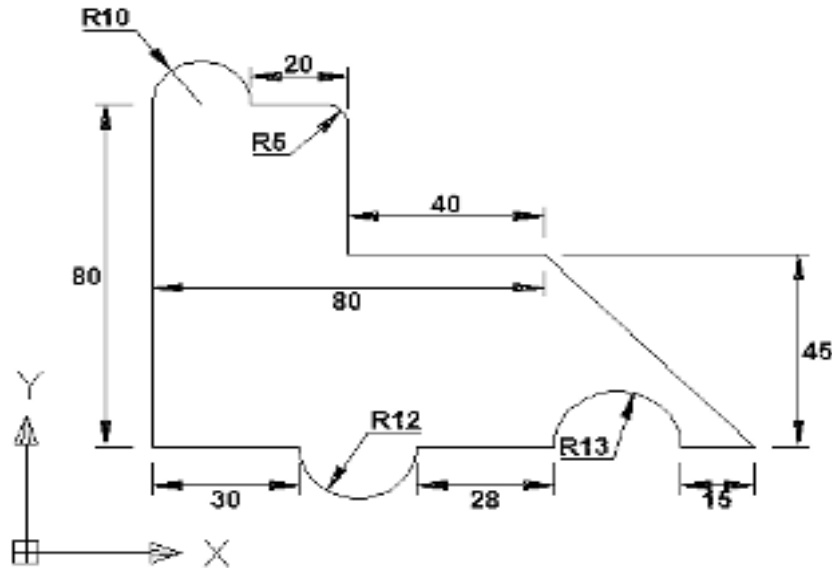
Max. Marks: 80

- N.B. :** (1) Question No 1 is Compulsory.
 (2) Attempt any three questions out of the remaining five.
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- 1 Attempt any FOUR [20]**
- What are 2D transformation matrices for i) Translation ii) Rotation iii) Scaling iv) Mirroring v) Shearing.
 - Differentiate between Augmented reality and Virtual reality
 - Write difference between Wireframe, Solid and surface Modeling
 - List and explain the part CNC programming codes for the following:
 - Rapid travel/positioning of the tool, ii) Homing iii) material cutting in circular fashion iv) Spindle off v) Absolute dimensioning system
 - What are the feedback devices used in NC/CNC machines
 - Differentiate between SLA and SLS.
- 2 a A triangle PQR with vertices P (2, 5), Q (6, 7) and R (2, 7) is to be reflected about the line $y = x+2$. Determine (i) the concatenated transformation matrix and (ii) coordinates of the vertices for the reflected triangle. [10]**
- b Explain Fused Deposition modeling with its advantages, disadvantages and applications. [10]**
- 3 a Write comparison between X-ray, CT scan, and MRI Scan [10]**
- b Explain the characteristics of the Bezier curve and plot a Bezier curve having 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. [10]**
- 4 a Write a part program for the following component as shown in figure assuming raw billet size of diameter 45 mm and length 82 mm for finished turning operation. Assume suitable data if any needed. [10]**



- b Write a CNC part program using G and M codes for contouring a component as shown in following figure having thickness 5mm. Assume cutter speed as 15m/min and feed rate as 0.2 mm/rev. Assume suitable data if needed. [10]



- 5 a Write short note on [10]
- Point cloud data
 - DICOM
- b Explain Selective Laser Sintering in detail with neat and clean diagram. [10]
- 6 a Write classification of RP Process, its advantages, disadvantages with its applications in Design. [10]
- b Explain the process of obtaining Cad solid model of body parts using CT output data. [10]

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- Question-1 is compulsory.
- Answer any three from remaining five questions.
- Assume any suitable data, wherever required, but justify the same. Assumptions made should be clearly stated.
- Illustrate the answers with sketches, wherever required.

I Answer any four of the following:

- List the inversions of the single slider mechanism and explain the working of the oscillating cylinder engine mechanism. (05)
- Compare Ackermann and Davis steering gear mechanism. (05)
- Compare involute and cycloidal gear teeth profiles. (05)
- Compare open and cross belt drive belt arrangements. (05)
- Derive an expression for Coriolis component of acceleration. (05)

- II a. The mechanism shown in fig.1 in which crank OA rotates in clockwise direction at uniform speed at 200 rpm. Determine the velocity and acceleration of slider 'P'. (12)

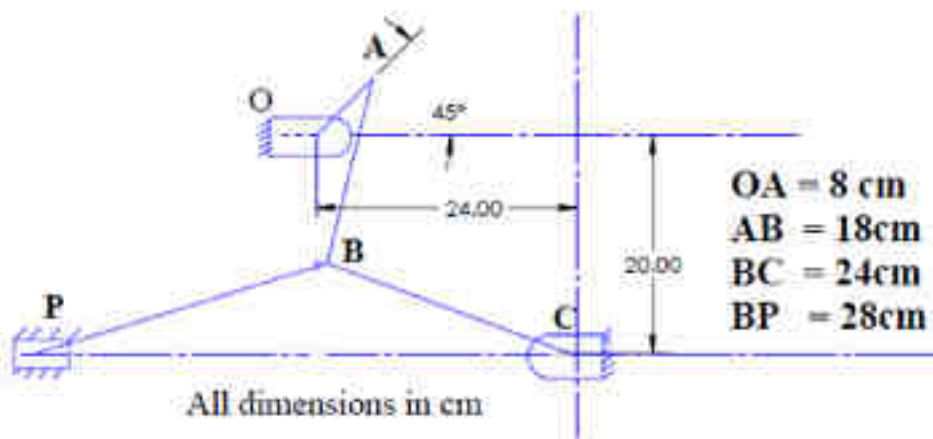


Fig. 1

- Derive an expression for velocity ratio of driving and driven shaft speed in a single Hooke's joint. (08)
- 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)
- Sketch a pantograph and explain its working. (06)
- Explain static forces acting on spur gear when two gears are in mesh with neat sketch. (04)

- IV a.** A flat belt drives a pulley, the angle of the lap being 120° . The belt is 100 mm wide (10) and 6 mm thick. The density of belt material is 1000 kg/m^3 . 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.
- IV b.** Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth (10) 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.
- Va.** Fig. 2 shows a mechanism in which crank OA rotates uniformly at 200 r.p.m. in the (14) clockwise direction. The various lengths are: OA = 150 mm ; AB = 450 mm; PB = 240 mm ; BC = 210 mm ; CD = 660 mm. Determine the velocity of slider D using the Instantaneous center method and also compare answer with the relative velocity method for the mechanism given mechanism.

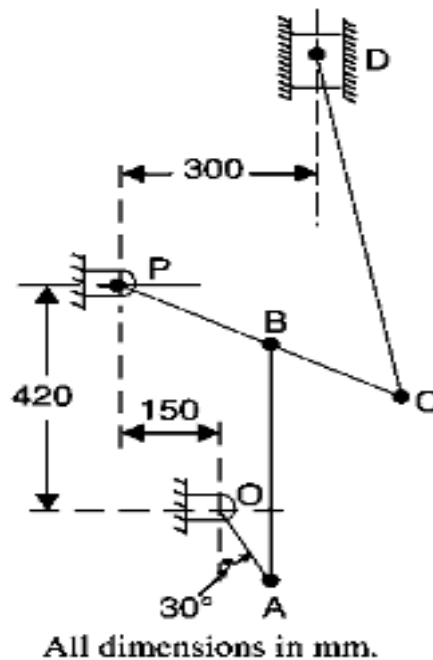


Fig. 2

- V b.** Explain self-locking and self-energizing brakes with the help of equations. (06)

- VI a.** A cam is rotating at 600 rpm operate a reciprocating roller follower the stroke of (10) follower is 5cm. Ascent takes place by SHM and descent by UARM. Ascent takes place by 120° and descent during 90° of cam rotation. Dwell between ascent and descent 50 degree. Determine the maximum velocity and maximum acceleration. Plot the displacement, velocity and acceleration diagram also marks salient features.
- VI b.** An epi-cyclic train of gears is arranged as shown in Fig. 3. The number of teeth on (10) the gears A and D are 40 and 90 respectively. Determine number of revolutions of the arm: 1. If, A makes one revolution clockwise and D makes half a revolution anticlockwise. 2. If, A makes one revolution clockwise and D is stationary.

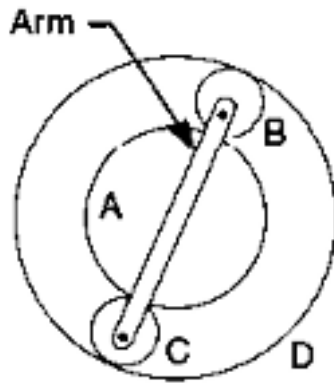


Fig.3