

(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) What is the value of $\int_0^{1+i} (x - y + ix^2) dz$ along the line from $z = 0$ to $z = 1 + i$ (5)

(b) Find a and b such that $\vec{F} = (axy + z^3)i + x^2j + bz^2xk$ is irrotational (5)

(c) A random variable X has probability mass function $p(x) = kx^3$; $x=1,2,3,4$ then find the value of k, mean, variance. (5)

(d) 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. (5)

Q.2 (a) Find the rank correlation coefficient between X and Y; (6)

X	17	13	15	16	6	11	14	9	7	12
Y	36	46	35	24	12	18	27	22	2	8

(b) A random variable has the MGF $M_X(t) = \frac{3}{3-t}$. Find mean and Variance of X. (6)

(c) Obtain Laurent's series expansions of $f(z) = \frac{z-1}{z^2-2z-3}$; $|z| > 3$. (8)

Q.3 (a) A coin is tossed. If it turns up heads two balls are drawn from urn A otherwise two balls are drawn from urn B. Urn A contains 3 black and 5 white balls. Urn B contains 7 black and one white ball. What is the probability that urn A was used, given that both balls drawn are black? (6)

(b) Fit a straight line $y = a + bx$ into the given data. (6)

x:	10	20	30	40	50
y:	22	23	27	28	30

(c) Prove that $\vec{F} = (6xy^2 - 2z^3)i + (6x^2y + 2yz)j + (y^2 - 6z^2x)k$ is irrotational. Find scalar potential of \vec{F} . Hence find the work done of moving particle from (1,0,2) to (0,1,1). (8)

- Q.4** (a) Using Green's Theorem evaluate $\int_c (xy + y^2)dx + x^2 dy$ and c is closed curve of the region bounded by $y = x$ and $y = x^2$. (6)
- (b) A machinist is expected to make engine parts with axle diameter of 1.75 cm. A random sample of 10 parts shows a mean diameter of 1.85 cm, with a S.D of 0.1 cm. Based on this sample, would you say that the work of the machinist is inferior? (6)
- (c) A random variable X follows a normal distribution with mean 14 and standard deviation 2.5 find (1) $P[X < 8]$ (2) $P[X > 18]$ (3) $P[12 < X < 15]$ Given: Area between $z=0$ and $z=2.4$ is 0.4918 ; Area between $z=0$ and $z=1.6$ is 0.4452 ; Area between $z=0$ and $z=0.8$ is 0.2882 ; Area between $z=0$ and $z=0.4$ is 0.1554. (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 regarded 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) Use Gauss's Divergence Theorem to evaluate $\iint_S \bar{N} \cdot \bar{F} ds$, where $\bar{F} = 4xi - 2y^2j + z^2k$ and S is region bounded by $x^2 + y^2 = 4, z = 0, z = 4$. (6)
- (c) Obtain both Line of regressions for the data given below (8)
Given $\sum X = 250 ; \sum Y = 300 ; \sum XY = 7900 ; \sum X^2 = 6500 ; \sum Y^2 = 10000$ and $n = 10$ (in usual notation)

- Q.6** (a) Evaluate Value of $\int_C \frac{\sin 2z dz}{(z + \pi/3)^4}$ where $C: |z| = 2$ (6)
- (b) The following data find the correlation coefficient to marks obtained by 11 students in 2 tests, one held at the beginning of the year and the other at the end of the year after intensive coaching: (6)

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) A die was thrown 132 times and the following frequencies were observed. (8)

No. obtained	1	2	3	4	5	6	Total
Frequency	15	20	25	15	29	28	132

Test the hypothesis that the die is unbiased at 5% level of significance.

(Given: Table value of χ^2 at 5% level of significance and 5 degree of freedom is 11.07)

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]
- Explain Newtonian and non-Newtonian Fluids [5]
 - Explain velocity potential function and stream function. [5]
 - What are the Applications of Bernoulli's equation in Orifice meter, Venturi meter, Rotameter and Pitot tube [5]
 - Define Reynolds number. Explain critical Reynolds number for flat plate and pipe conduit. [5]
 - Explain various Major and Minor losses for flow through pipe [5]
 - Explain Streamlined and bluff bodies
- 2 a The flow field is given by $V = xyi + 2yz j - (yz + z^2) k$ [10]
- Show that it represents a possible 3-D steady incompressible continuous flow
 - Is this flow rotational or irrotational? If rotational determine at the point (2,4,6)
 - angular velocity, b) vorticity, c) shear strain, and d) Dilatency
- b Derive an expression for total pressure and centre of pressure for a vertically immersed surface. [10]
- 3 a What is venturimeter? Derive expression of discharge through venturimeter. [10]
- b 360 lit/sec of water is flowing in pipe. The pipe is bent by 120° . The pipe bend measures 360 mm x 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 2.4m above the entrance. Find the direction and magnitude of resultant force. [10]
- 4 a A liquid of viscosity of 0.9 poise is filled with horizontal plates 10 mm apart. If the upper plate is moving at 1 m/s with respect to the lower plate which is stationary and pressure difference between two sections 60m apart is 60 kN/m^2 . **Determine** i) The velocity distribution ii) The discharge per unit width iii) The shear stress on upper plate. [10]
- b Derive Euler's equation of motion in rectangular Cartesian co-ordinate system and from this derive Bernoulli's Equation for liquid. State assumptions made in the derivation of Bernoulli's Equation [10]
- 5 a Derive the Hagen-poiseuille Equation. [10]
- b Water is flowing through a pipe having diameter 600 mm and 400 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 350 kN/m^2 and the pressure at upper end is 100 kN/m^2 . Determine the difference in datum head if the rate of flow through the pipe is 60 litre/sec. [10]

- 6 a Two reservoirs with a difference in elevation of 15m are connected by the three pipes in series. The pipes are 300 m long of diameter 30 cm, 150 m long of 20cm diameter and 200 m long of 25 cm diameter respectively. The friction factors for three pipes are 0.018, 0.020 and 0.019 respectively and which account for friction and all losses. **Determine** the flow rate in lit/sec. The loss of coefficient for sudden contraction for dia.30 cm to 20 cm is equal to 0.24. [10]

- b Using the laminar boundary velocity distribution: [10]

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

(i) Determine boundary layer thickness in terms of Re

(ii) Check if boundary layer separation occurs

(3 Hours)

Total 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**
- What are the different types of instantaneous centres?
 - Classify cam in detail
 - Explain Self energizing and Self-locking brake
 - What are the different types of constrained motion?
 - State and explain work energy principle and conservation of energy
2. (A) The mechanism, as shown in Fig. 1 the slider D is constrained to move on a 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: **12**
- Velocity of slider D,
 - Angular velocity of links AB, CB, and BD
- By instantaneous center method
 - By relative velocity method

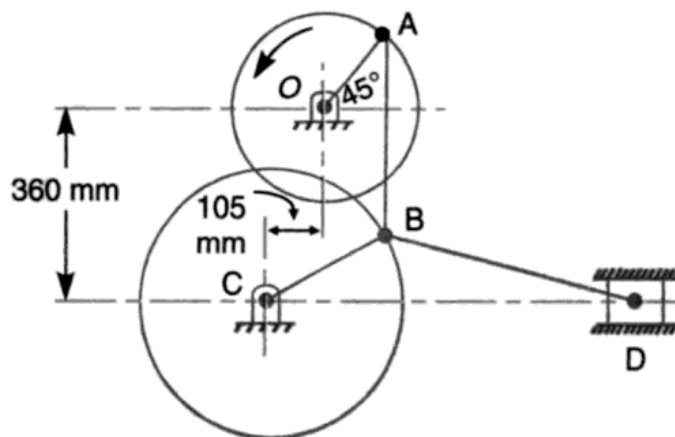
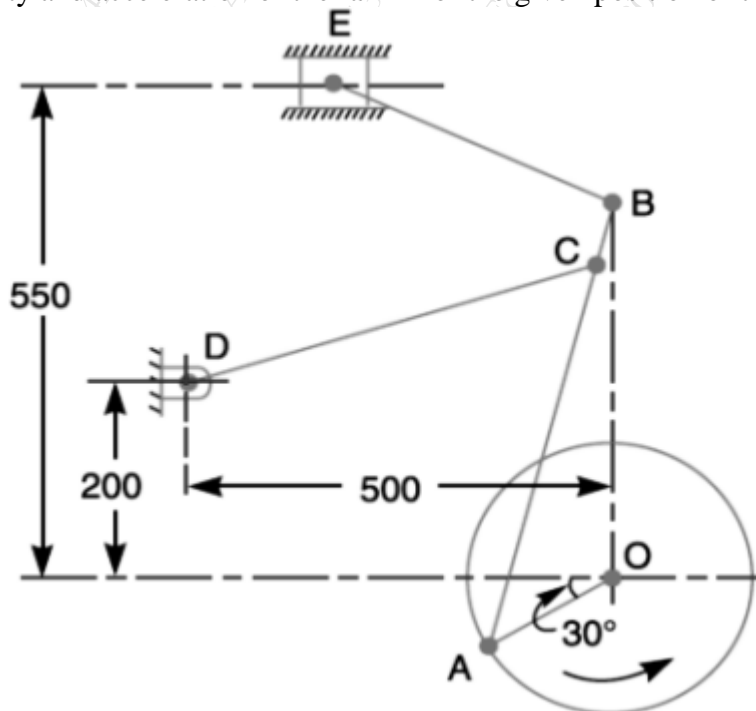


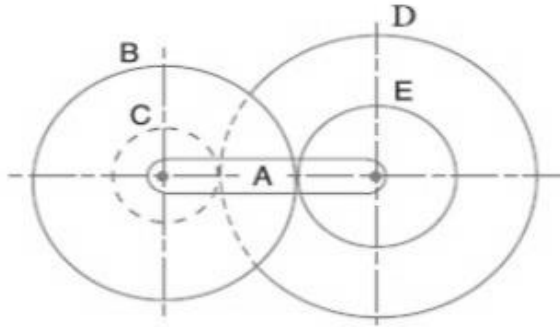
Fig. 1

- (B) Draw a neat sketch of Tchebicheff mechanism and prove that the length of links must be in a ratio of 1:2:2.5 **08**
3. (A) Figure shows the mechanism of a radial valve gear. The crank OA turns uniformly 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. **14**



- (B) What is the effect of centrifugal tension on power transmitted in belt drive? **06**
4. (A) In an open belt drive, the diameters of the larger and smaller pulley are 1.2 m and 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. **10**
- (B) A cord wrapped around a solid cylinder of radius 'r' and mass 'm'. The cylinder is released from rest. Determine the velocity of its centre of mass after it has moved down a distance 'h'. **10**

5. (A) In a reverted epicyclic gear train, the arm A carries two gears B and C 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 **10**



- (B) Compare involute and cycloidal gear teeth profiles **05**
- (C) What is chordal action in chain? **05**
6. (A) The number of teeth on each of the two equal spur gears in mesh is 50. The teeth 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. **10**
- (B) 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° and descent during 50° of cam rotation. Dwell between ascent and descent 60° . Sketch displacement, velocity, acceleration, and jerk diagram. **10**

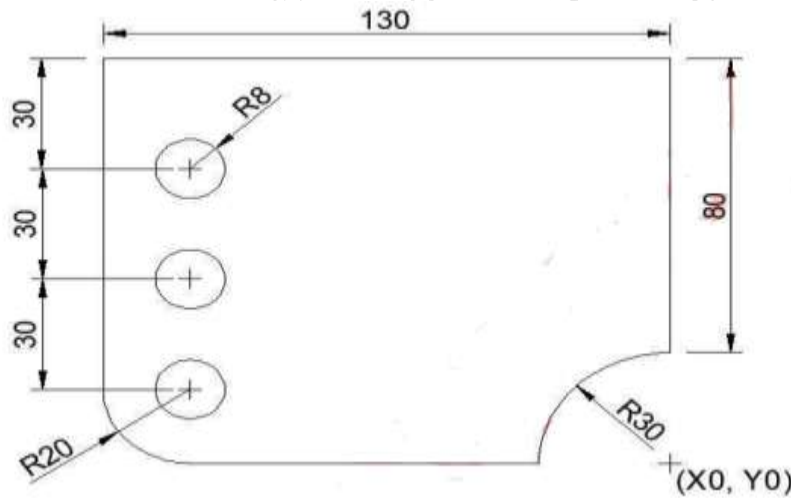
Duration: 3hrs

[Max Marks:80]

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- 1 Attempt any **FOUR** [20]
a Write short note on scope of Virtual Manufacturing
b Explain use of following words in manual part programming
i) N ii) S iii) F iv) T v) X,Y,Z and U,V,W.
c Explain translation, scaling, rotation and reflection with suitable examples
d Write difference between Wireframe, Solid and surface Modeling
e What do you mean by interpolation and approximation curve?
- 2 a Write the difference between Bezier curves, Hermite Curves and B-spline curves with examples. [10]
b Explain in brief the elements of CNC machine tool system. Write down advantages, limitations and applications of CNC machine tool system. [10]
- 3 a Explain the process of obtaining CAD solid model of body parts using CT output data. [10]
b Explain in detail Virtual Manufacturing, its socio-economic aspects, and future trends. [10]
- 4 a Explain working principle, application, advantages & disadvantages of Stereolithography Apparatus (SLA) [10]
b Write classification of RP processes its advantages & disadvantages. Also explain RP applications in design. [10]
- 5 a Write short note on [10]
i) Homogeneous Coordinate system.
ii) Non Contact surface scanning in medical imaging

- b Write a CNC part program using G and M codes for contouring a component of thickness 10mm. Also drill holes of 16mm diameter as shown in figure. Assume cutter speed as 15m/min and feedrate as 0.2 mm/rev. [10]



- 6 a 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 0.2. [10]
- b A triangle PQR with vertices P (2,5), Q (6,7) and R (2,7) is to be reflected about the line $y=0.5x+3$. Determine (i) the concatenated transformation matrix and (ii) coordinates of the vertices for the reflected triangle. [10]

(3 Hours)

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1 Attempt any FOUR

[20]

- a Compare between SCR and DIAC
- b Draw and Explain low pass filter
- c What is an operational amplifier? Explain its characteristics
- d Differentiate between microprocessor and microcontroller
- e State and prove De-Morgan's theorems

2 a. Explain 180 degree mode of operation of inverter

[10]

b. Explain the architecture of MSP 430 microcontroller

[10]

3 a. Draw the circuit diagram of astable multivibrator and explain its operation.

[10]

b. Define and Explain specification parameter of digital logic family.

[10]

4 a. Explain the working principle of single phase bridge inverter circuit.

[10]

b. List various speed control methods of induction motor. Explain voltage control method with a suitable diagram.

[10]

5 a. What is a 555 timer? Write its applications and explain astable multivibrator with associated circuit diagram and waveforms.

[10]

b. Write difference between assembly programming and C programming also write the applications of microcontroller as Speed Measurement using Proximity Sensor.

[10]

6 a. Write a note on a) BLDC Motor b) Servo Motor

[10]

b. Draw and explain the working of multiplexer and de-multiplexer.

[10]