Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Examination January 2010

Subject code: 710802 Subject Name: Computer Aided Machine Design

Date: 22 / 01 /2010 Time: 12.00 – 2.30 pm

Total Marks: 60

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Assume suitable additional data if required stating clearly the assumptions made in your answer book.**
5. **Illustrate your answer with neat sketches wherever required.**

Q.1 **(a)** Explain the meaning of 'Homogeneous Coordinate System' and its importance. **06**

(b) Consider a triangle ABC having coordinates A (5, 5), B (8, 5) and C (5, 10). Determine the new vertex positions if: **06**

(i) The triangle is rotated by 60^0 anticlockwise about vertex A.

(ii) The triangle is scaled by 2 times in X direction and 3 times in Y direction about vertex A.

(iii) If is mirrored about a line $y = 2x + 4$.

Q.2 **(a)** State and explain the various properties of Bezier curves. **06**

(b) Given B_0 [0,0], B_1[1,3], B_2 [2,3], B_3 [4,1] and B_4 [3,0]. Determine 5 points on the Bezier curve. Obtain the equation for a Bezier curve in the following matrix form for the above case. P(t) = [T] [N] [G] **06**

OR

(b) Explain parametric representation of ellipse. Generate an ellipse with semimajor axis a = 4 and semiminor axis b = 1 inclined at 30^0 to the horizontal with center at (2, 2). **06**

Q.3 **(a)** Explain in brief **06**

(i) Various representation schemes for Solid Modeling

(ii) Graphic standards.

(b) Prove that in case of 2D transformation of a triangle ABC, result obtained after it being reflected about the X axis first and then about line y = - x will be same as when the triangle is rotated about the origin by an angle $\theta = 270^0$. **06**

OR

Q.3 **(a)** Write Bresenham's algorithm for scan conversion of an ellipse with the help of a flowchart. **06**

(b) Explain in detail the various capabilities of ProE and Inventor professional software. **06**

Q.4 **(a)** Prepare an algorithm and write a C program for the design of flange coupling. **06**

(b) Write short notes on **06**

(i) B-rep

(ii) Constructive solid geometry (CSG)

OR

Q.4 **(a)** Draw a flow chart and write a C program for the design of Spindle of lathe. **06**

(b) Explain clearly the difference between cubic spline and normalized cubic spline with examples. **06**

Q.5 **(a)** Explain Johnson's method of optimum design stating basic steps and classification. **06**

(b) A spur gear drive is to be designed for a minimum weight (neglect weight of other parts except gear). Input shaft speed is 350 rpm and output shafts speed requirements are 500,350,250 rpm respectively. Input has a cluster of three gears which can match with a particular gear on output shaft by shifting the lever to get desired speed. The distance between any two gears fitted on output shaft should be at least twice the width of the gear. The power to be transmitted by the pair should be at least 1 kW. The restriction on the number of teeth is minimum 16 and maximum 100. The transmission ratio of gear width to its module should be between 10 to 12. (Assuming all gears has the same modules.) Formulate the optimization problem to find the module and number of teeth on various gears. **06**

OR

Q.5 **(a)** Draw 2-D surface of constraints naming types of constraints and points. Explain design vector, design variable and constraints. **06**

(b) In light weight equipment, a shaft is transmitting a torque of 900 N-m and has a rigidity of 90 N-m/degree. Assume factor of safety 1.5 based on yield stress. Design shaft with minimum weight using Johnson's method. Find diameter and length, assume maximum shear stress theory of failure **06**

$$\tau_{\max} \leq \frac{0.5 S_y}{FOS}$$

Use following data for materials.

Material	Mass Density (ρ) Kg/m^3	Yield Strength MPa	Shear Modulus GPa
Steel alloy	8500	130	80
Al. alloy	3000	50	26.7
Titanium alloy	4800	90	40
Magnesium alloy	2100	20	16

Formulae : $\frac{M_T}{J} = \frac{\tau_{\max}}{r} = \frac{G\theta}{L}$, $\frac{M_T}{\theta} = K = \frac{GJ}{L}$

Where K = Torsional rigidity in N-m/radian
M_T = Torque rating in N-m
r = radius of shaft
L = length of shaft
S_y = Yield stress in N/m^2
G = Modulus of rigidity in N/m^2

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