Dr. Anshul Sharma. 21/11/2023 (E) (62)

**Roll Number:** _____

राष्ट्रीय प्रौद्योगिकी संस्थान हमीरपुर
हमीरपुर (हि॰प्र॰) – 177 005 (भारत)
**NATIONAL INSTITUTE OF TECHNOLOGY HAMIRPUR**
**HAMIRPUR (H.P.) - 177 005 (INDIA)**
(An Institute of National Importance under Ministry of HRD)

**Department of Mechanical Engineering**

**END SEMESTER THEORY EXAMINATION, Odd Semester 2023-24**

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| B. Tech. (7th Semester): ME4 | Course Code: ME - 412<br>Course Name: Computer Aided Design |
| November 21, 2023 | Tuesday, 02:30 PM – 05:30 PM |
| Time: 03 Hours, Max Marks: 50 | Name of Faculty: Dr. Anshul Sharma |

***Note:*** ***Attempt all questions***
***Assume missing data, if any, suitably***
***Draw neat sketches, wherever applicable.***

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| **Q1 (a)** | Explain briefly the typical CAD system Architecture. | **[3 Marks]** |
| **Q1 (b)** | A cubic Bezier curve is defined by the points $P_0$ (1, 1), $P_1$ (2, 3), $P_2$ (4, 4) and $P_3$ (6, 1). Calculate the coordinates of the parametric midpoint of this curve and verify that its tangent is 1/7 at this point. | **[5 Marks]** |
| **Q2 (a)** | What do you understand by Solid Modelling? Discuss the properties of the solid modelling. | **[5 Marks]** |
| **Q2 (b)** | Do a comparative analysis of Constructive Solid Geometry (CSG) and Boundary representation (B-rep) method with an example. | **[5 Marks]** |
| **Q3 (a)** | Discuss any two types of analytical surfaces in the context of their parametric equations, applications and properties. | **[4 Marks]** |
| **Q3 (b)** | Derive the parametric equation for the B-spline surface patch defined by (n+1) × (m+1) array of control points. Also, discuss the characteristics and type of surface smoothness illustrated by the general B-spline surface patch. | **[4 Marks]** |
| **Q4 (a)** | What is homogeneous transformation? Explain all the elements of the homogeneous transformation matrix [$T$]. Also, discuss the various types of geometrical transformations used by the CAD systems/platforms. | **[4 Marks]** |

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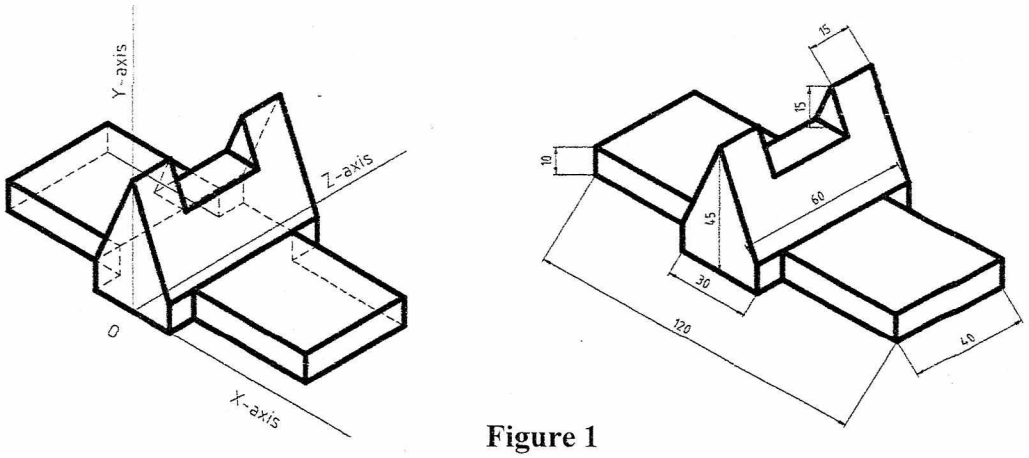
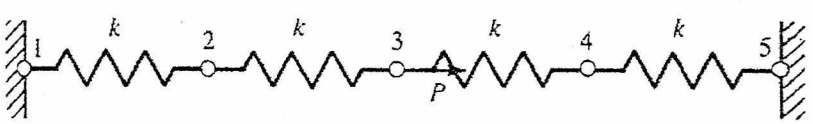
| **Q4 (b)** | A machine block is shown in Figure 1. Using transformations, represent the three principal views (Front, Top and Right) and Isometric view of machine block with respect to screen/viewing coordinates.<br>  <br><br>**Figure 1** | **[5 Marks]** |
| **Q4 (c)** | Consider rotating a position vector in the fixed coordinate system *X Y Z*, that is, MCS, by the following rotations in the following order:<br>(i) 90° about the *Z*-axis,<br>(ii) 45° about the *Y*-axis and<br>(iii) 60° about the *X*-axis.<br><br>Also, Analyse the effect on the final output, if the order of the abovementioned transformations is reversed. | **[5 Marks]** |
| **Q5 (a)** | Briefly describe the general steps involved in the implementation of the finite element method. Explain the terms Interpolation Function, Kronecker Delta Property, Discretization used as concepts in the finite element method. | **[4 Marks]** |
| **Q5 (b)** | For the spring assemblage shown in Figure 2,<br>(a) Obtain the global stiffness matrix [*K*] of the assemblage using superimposing the stiffness matrices of the individual springs (Direct Stiffness Method).<br>(b) If nodes 1 and 5 are fixed and a force *P* is applied at node 3, determine the nodal displacements.<br>(c) Determine the reactions at the fixed nodes 1 and 5 using back substitution method.<br>  <br><br>**Figure 2** | **[6 Marks]** |