

Birla Institute of Technology and Science Pilani

ME G611: Computer Aided Analysis and Design Second Semester 2022-23

Comprehensive Exam Part II (open book)
8th May, 2023

Maximum marks: 35
Maximum duration: 3h

1. Determine the first three third order B-spline basis functions $N_{1,3}, N_{2,3}, N_{3,3}$ using the recursive method. Use the following knot vector. $u_v = [0, 0, 0, 1, 4, 9, 15]$.
2. A Bezier curve has the following control points $P_0 = (0, 0), P_1 = (0, 1), P_2 = (1, 0), P_3 = (1, 1)$. Determine the control points for the subdivided Bezier curve starting from $u=0.2$ to $u=0.5$.
3. A spline is defined by the following three functions
 $r(u) = 1 + u$ for $u \leq -1$
 $r(u) = 1 - u$ for $u \geq 1$
 $r(u) = a_0 + a_1u + a_2u^2 + a_3u^3 + a_4u^4$ for $u \in (-1, 1)$.
Find all the coefficients a_i . Plot the approximate shape of the spline for $u \in [-3, 3]$
4. Write the equation of the surface which is generated using the following algorithm,
 1. A line segment is made from the point A(10,-5,0) to B(10,5,0) using the parameter $u \in [-1, 1]$.
 2. The line segment is rotated about the axis passing through the mid-point of AB and parallel to z-axis (The angle turned is the parameter $v \in [0, \pi]$).
 3. The line segment is further rotated about y-axis. (The angle turned is $2v$).

Determine the surface normal $\mathbf{n} = r_u \times r_v$ at the points $u = 0, v = 0$ and $u = 0, v = \pi$.

$$r_u := \frac{\partial r(u,v)}{\partial u}, r_v := \frac{\partial r(u,v)}{\partial v}$$

5. Draw the three orthographic views of the solid described by the following openscad code, write down the number of vertices(V), edges(E), faces(F), loops(L), genus number(G), shell number(S), and the euler characteristic χ of the solid.

```
difference() {
difference()
{
union() {
cube([10, 10, 10], center=true);
cube([2, 2, 20], center=true);
}
translate([0, 5, 0])
cube([2, 2, 20], center=true);
}
cube([2, 2, 2], center=true);
}
```