# Exercise no 11

New commands: BOX, SPHERE, CONE, 3DORBIT, UNION, SUBTRACT, INTERSECT, HIDE, SHADE, EXTRUDE, VIEWPOINT, REVOLVE, 3DARRAY, SECTION, SLICE

Show tabs: 3D TOOLS, VISUALIZE

11.1. Union, intersection and subtraction of 3D objects

1. Begin a new drawing and change current colour to green.
2. Use BOX to draw a cube centered at 0.0, 0.0, 0.0 and having edge length equal to 120 units.
3. Change current colour to yellow.
4. Use SPHERE to draw a sphere centred at 0.0, 0.0, 0.0 and having radius of 90 units.
5. Create three copies of both 3D objects.
6. Perform the following operations on those pairs of objects: UNION; INTERSECT; SUBTRACT twice - to subtract cube from sphere and to subtract sphere from cube.
7. Practise 3DORBIT tool for changing viewpoints. Apply various visual styles, e.g.: 2D wireframe, 3D wireframe, conceptual, realistic.
8. Hide the invisible parts of created 3D objects using HIDE command. Execute SHADE command.

| union | intersection | sphere - cube | cube - sphere |
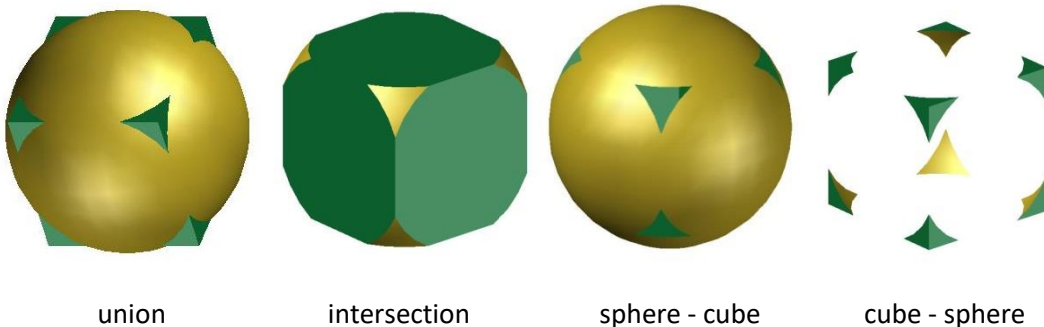
11.2.   Nut model

1. Begin a new drawing and change current colour to blue.
2. Use POLYGON to draw a hexagon in XY plane inscribed in a circle centred at 0.0, 0.0, 0.0 and having a radius of 25 units.
3. EXTRUDE this hexagon to the height of 29 units.
4. Use VIEWPOINT command to change the viewpoint: specify angle in XY plane from X axis equal to 320° and angle from XY plane equal to 30°.
5. Change current colour to red.
6. Use CONE to create two cones: the first one with base centred at 0.0, 0.0, 0.0 and having base radius and height of 50 units, and the second one centred at 0.0, 0.0, 29.0, having base radius of 50 units and height of -50 units.
7. Apply INTERSECT to determine the common part of those three 3D objects.
8. Change current colour to green and use CYLINDER command to create a cylinder with base centred at 0.0, 0.0, 0.0 and having radius of 12 units, and height of 50 units.
9. Create a hole in the nut using SUBTRACT. Select appropriate visual style.
10. Use the FILLET or FILLETEDGE command to round with radius R=1 the outer edges of the nut and use the command CHAMFER or CHAMFEREDGE chamfer the internal edges with both distances equal to 1.
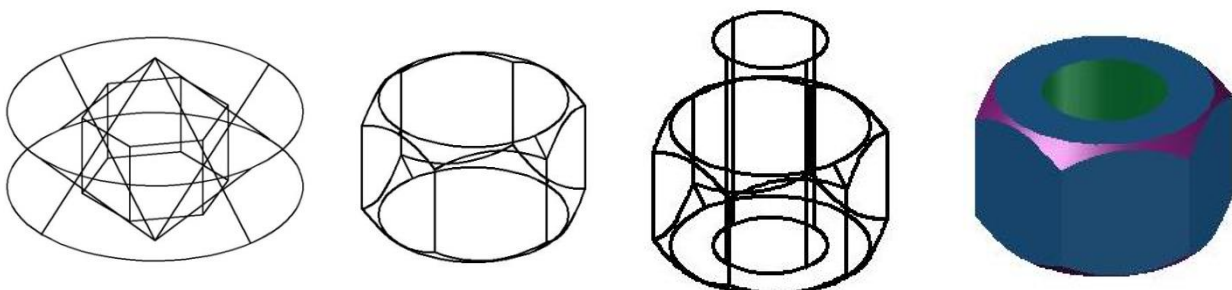
11.3. Ball bearing

1. Begin a new drawing and create the following layers:

AXIS	BLUE COLOUR	ACAD_ISO04W100	0.20MM
BEARING	VIOLET COLOUR	CONTINUOUS	0.30MM
SPHERES	GREEN COLOUR	CONTINUOUS	0.30MM

2. On the AXIS layer draw a line from -20.0, 0.0, 0.0 to 90.0, 0.0, 0.0 (axis of revolution).
3. On the BEARING layer use PLINE to draw cross-sections of bearing rings (without dimensions).
4. On the SPHERES layer use SPHERE command to draw two spheres of radius equal to 10 units, centred at 15.0, 70.0, 0.0 and 55.0, 70.0, 0.0.
5. On the BEARING layer apply REVOLVE to both cross-sections of bearing rings indicating the axis drawn as axis of revolution and specyfing 360° as the angle to fill.
6. Change the observation point to isometric view.
7. On the SPHERES layer apply 3DARRAY to draw remaining spheres: select both spheres, choose polar array, enter 15 as the number of items in the array, specify 360° as the angle to fit and indicate the axis drawn before as the axis of revolution.
8. Choose appropriate visual style. Use 3DORBIT to check the bearing.
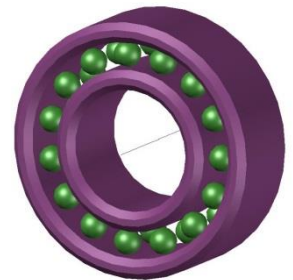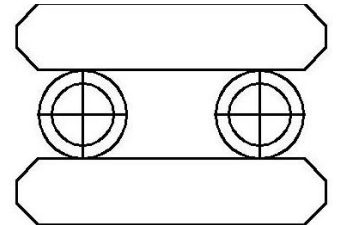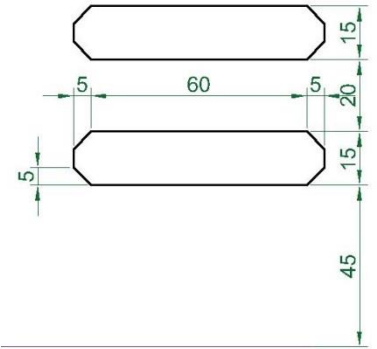
11.4. Bearing cover

1. Begin a new drawing and create the following layers:

COVER	GREEN COLOUR	CONTINUOUS	0.30MM
HOLES	YELLOW COLOUR	CONTINUOUS	0.30MM
SECTION	RED COLOUR	CONTINUOUS	0.30MM

2. On the COVER layer use PLINE to draw the contour of cover (without dimensions) as a **single closed** polyline – start at 10.0, 20.0, 0.0 (point A).
3. Use REVOLVE to create the cover, picking X axis as the axis of revolution and specyfing 360° as the angle to fit. Set the isometric view and check the 3D object created.
4. Set view to RIGHT.
5. On the HOLES layer use CYLINDER to draw a cylinder with base centred at 0.0, 105.0, 0.0 having a radius of 5 units and height of 100 units.
6. Replicate the cylinder 6 times using 3DARRAY or ARRAY. Apply polar array centred at 0.0, 0.0, 0.0 and 360° as the angle to fit.
7. Apply SUBTRACT to subtract cylinders from the body of cover, thus creating six screw holes in the cover.
8. Check the 3D object created using 3DORBIT and select the appropriate visual style.
9. On a proper layer apply SECTION to create a section of the cover indicating the YZ plane passing through point 0.0, 0.0, 0.0 as section plane.
10. Apply SLICE to divide the cover into two halves, keeping both. Choose the YZ plane passing through point 0.0, 0.0, 0.0 as the slicing plane.
11. Use MOVE to separate both parts of the cover.
12. Set isometric view.