ATME COLLEGE OF ENGINEERING

13th KM Stone, Bannur Road, Mysore - 570 028

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

NOTES

Course: Computer Aided Electric Drawing

Course Code:21EE741

Semester: VII

Prepared by

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Asst. Professor

Department of EEE,

ATME College of Engineering

INSTITUTIONAL VISION AND MISSION

VISION:

- Development of academically excellent, culturally vibrant, socially responsible and globally competent human resources.

MISSION:

- To keep pace with advancements in knowledge and make the students competitive and capable at the global level.
- To create an environment for the students to acquire the right physical, intellectual, emotional and moral foundations and shine as torchbearers of tomorrow's society.
- To strive to attain ever-higher benchmarks of educational excellence.

Department Vision and Mission

Vision:

To produce Electrical & Electronics Engineers through greatest quality of technical education, technical skill training and intellectual capacity building of individuals.

Mission:

- To provide knowledge to students that builds a strong foundation in the basic principles of electrical engineering, problem solving abilities, analytical skills, soft skills and communication skills for their overall development.
- To offer outcome based technical education.
- To encourage faculty in training & development and to offer consultancy through research & industry interaction.

Program Educational Objectives (PEOs)

PEO1:

To produce Electrical and Electronics Engineers who will exhibit the technical and managerial skills with professional ethics for the societal progress.

PEO2:

To make students continuously acquire, enhance their technical and socio-economic skills and also to be globally competent.

PEO3:

To impart the experience of research and development to students so that they develop abilities in offering solutions to relevant diverse career path.

PEO4:

To produce quality engineers with a team leading capabilities, also show good coordination to contribute towards real time application of projects

Program Outcomes (POs)

Engineering Graduates will be able to:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design / Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Graduates will develop the abilities to:

PSO1: Apply the concepts of Electrical & Electronics Engineering to evaluate the performance of power systems and also to control industrial drives using power electronics.

PSO2: Demonstrate the concepts of process control for Industrial Automation, design models for environmental and social concerns and also exhibit continuous self-learning.

Department of Electrical and Electronics Engineering

Computer Aided Electrical Drawing

Module-1
Winding Diagrams:
(a) Developed Winding Diagrams of D.C. Machines: Simplex Double Layer Lap and Wave Windings.
(b) Developed Winding Diagrams of A.C. Machines:
(c)Integral and Fractional Slot Double Layer Three Phase Lap and Wave Windings.
(d) Single Layer Windings – Un-Bifurcated 2 and 3 Tier Windings, Mush Windings, Bifurcated 3 Tier Windings2. Single line diagrams of generating stations and substations.

Module-2:

Single Line Diagrams: Single Line Diagrams of Generating Stations and Substations Covering Incoming Circuits, Outgoing Circuits, Busbar Arrangements (Single, Sectionalised Single, Main and Transfer, Double Bus Double Breaker, Sectionalised Double Bus, One and a Half Circuit Breaker Arrangement, Ring Main),Power Transformers, Circuit Breakers, Isolators,Earthing Switches,Instrument Transformers, Surge or Lightning Arresters, Communication Devices (Power-Line Carrier) and Line Trap

Module-3:

Electrical Machine Assembly Drawings Using Design Data, Sketches or Both:
Transformers - Sectional Views Of Single And Three Phase Core And Shell Type Transformers .

Module-4:

Electrical Machine Assembly Drawings Using Design Data, Sketches or Both:
D.C. Machine - Sectional Views of Yoke with Poles, Armature and Commutator dealt separately.

Module-5:
Electrical Machine Assembly Drawings Using Design Data, Sketches or Both:
Alternator – Sectional Views of Stator and Rotor dealt separately

Module-5

ALTERNATORS

Objective: to draw the sectional views of stator and rotor

Problem 1:

Draw end view and elevation of the stator stamping of the given below dimensions:

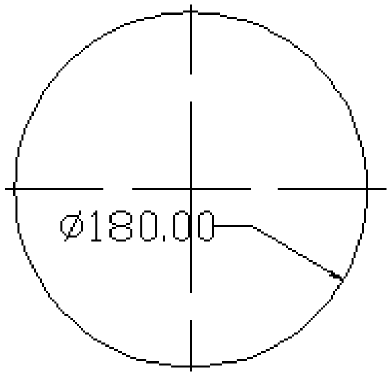
Inside or air gap dia of stator stamping	**= 18cm**
Slot size	**= 2.9*0.95cm**
Depth of iron behind the stator slot	**= 4cm**
Length of stator stamping	**=13.5 cm**
One radial cooling duct	**=1cm wide**
Total slots	**=36**

Solution:

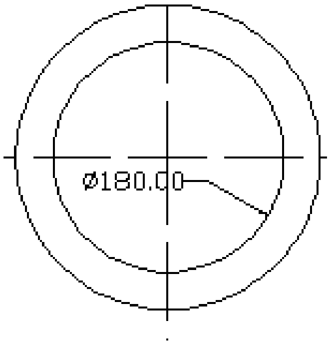
1. Inside dia of stator = 18cm = 180mm
2. Slot details:
3. Depth of iron core in stator = 4cm = 40mm
4. Outer dia of stator = Inner dia of stator + 2(depth of slot) + 2(thickness of iron core)
   = 180 + 2 * (29) + 2 * (40)
   = 318mm
5. Slot angle = 360/no .of slot = 360/36 = 10˚
6. Length of stator stamping = 13.5cm = 135mm
7. No. of pulling duct = 1 (of 1cm width)

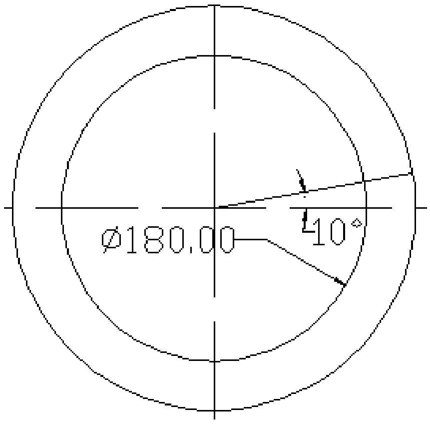
Step 1:
Units – millimeter
Set limits: Limits: left corner 0,0 >> right corner : 1500,1500 >> zoom >> all

Step 2:
Draw a circle of dia 180mm to obtain inside dia of stator stamping



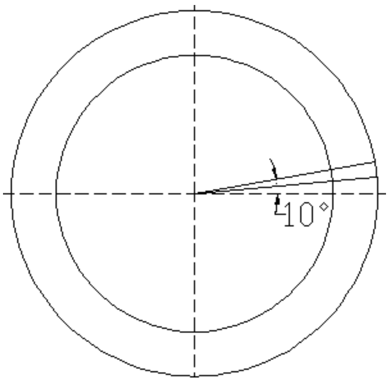
Step 3: Slot details:
Offset the circle by 29mm outwards (because height of slot = 29mm)

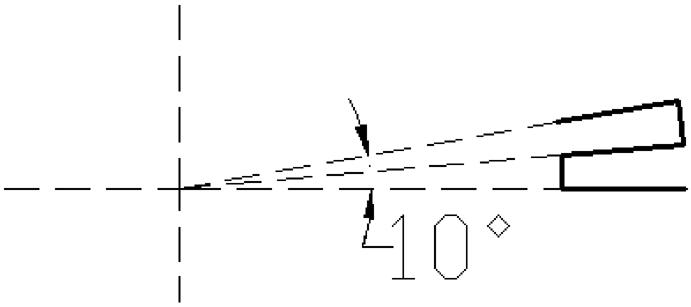


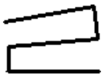


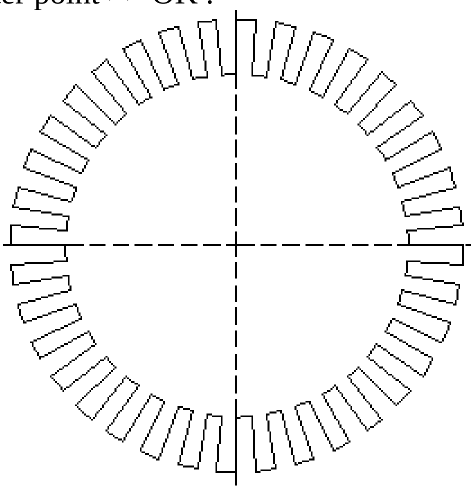
Step 4: To include slots:
Draw a line from centre of circle @119<10 (since 180/2 = 90mm radius + 29mm = 119mm) as shown above

Step 5: To draw the slot with in 10˚
Obtain the midpoint within the arc of 10˚, draw an inclined line at midpoint from center and trim to get a slot.



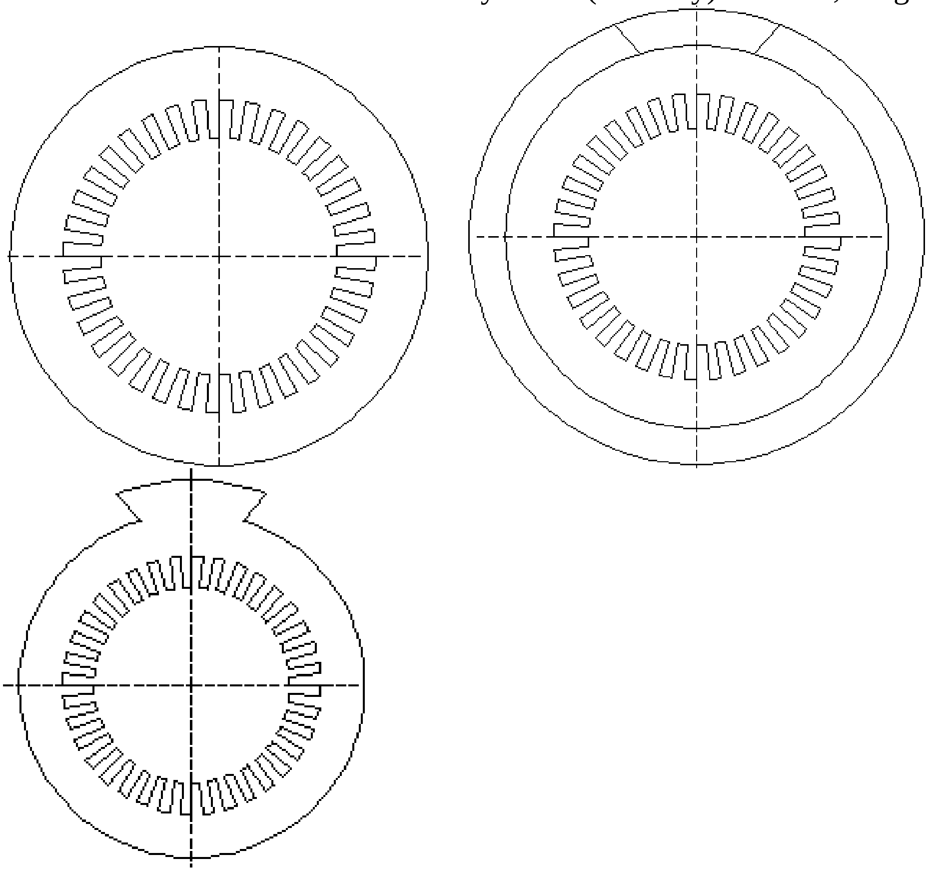


Step 6:
To include 36 slots: polar array >> no of items – 36 >> angle to fill – 360 >> select object  >> specify center point >> OK .

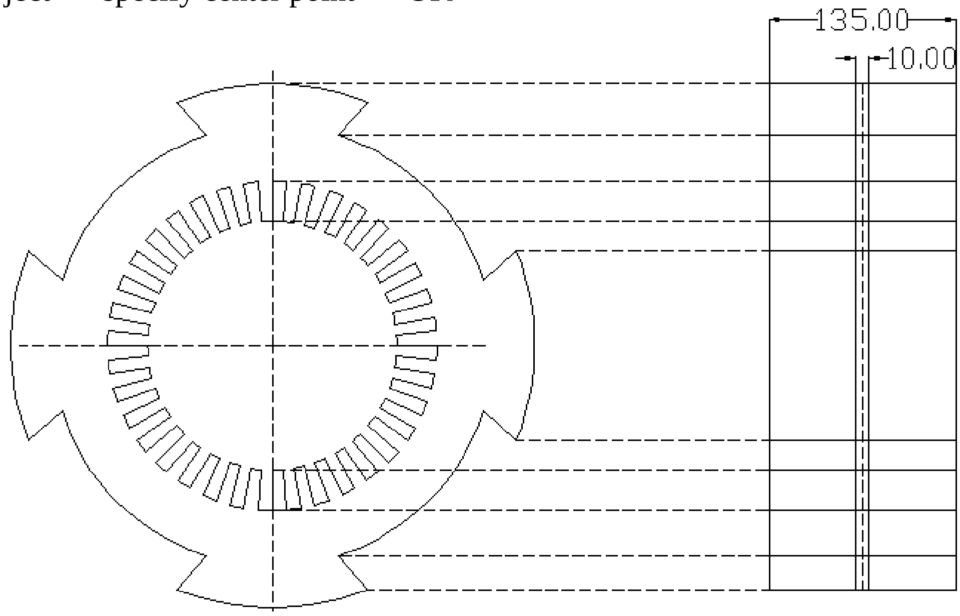


Step 7:

- Draw outer dia of stator as 318mm as calculated
- Offset the outer dia of stator by 30mm(arbitrary) and trim, we get



- Draw an inclined line ‘ab’ & mirror it as shown
- After trim and then : polar array >> no of items – 4 >> angle to fill – 360 >> select object >> specify center point >> OK



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Step 8: **Elevation :**

- Project the lines as shown above
- Draw a line of length 135mm (given)
- Draw the radial pulling duct of 1cm = 10mm as shown above

Problem 2 :

Draw end view and elevation of the rotor stamping of the given below dimensions:

Rotor outside diameter	**=17.88cm**
Number of slots	**=31**
Size of slots (circular) dia	**=1cm**
Slot opening	**=2mm**
Length of rotor	**=13.5cm**
One radial cooling duct	**=1cm wide**
Dia of shaft below rotor stamping	**=3.5cm**

Solution:

1. Outer dia of rotor = 17.88cm = 18cm = 180mm
2. Inner dia of rotor = dia of shaft = 35mm
3. Slot details :

Type of slot – circular :

Assume: Depth of slot opening = 2mm, dia of slot = 8mm

No. of slots = 31

Slot angle = 360/ no of slots = 360/31 =11.61 = 12˚

No of slots = 360/slot angle = 360/12 = 30

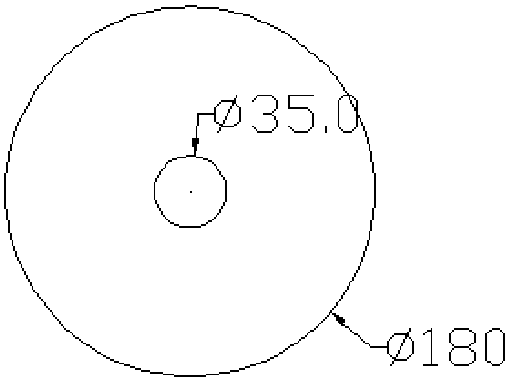
4. Length of rotor stamping = 13.5cm = 135mm
5. No of radial cooling duct = 1 ; whose width = 1cm = 10mm

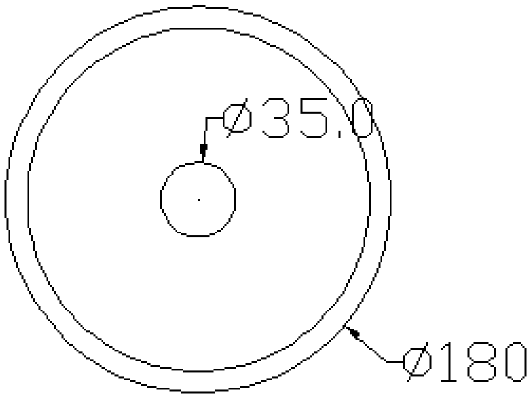
Step 1:

Units – millimeter

Set limits: Limits: left corner 0,0 >> right corner : 1000,1000 >> zoom >> all

Step 2: Draw the 2 circles : Inner dia of rotor – 35mm, outer dia of rotor – 180mm

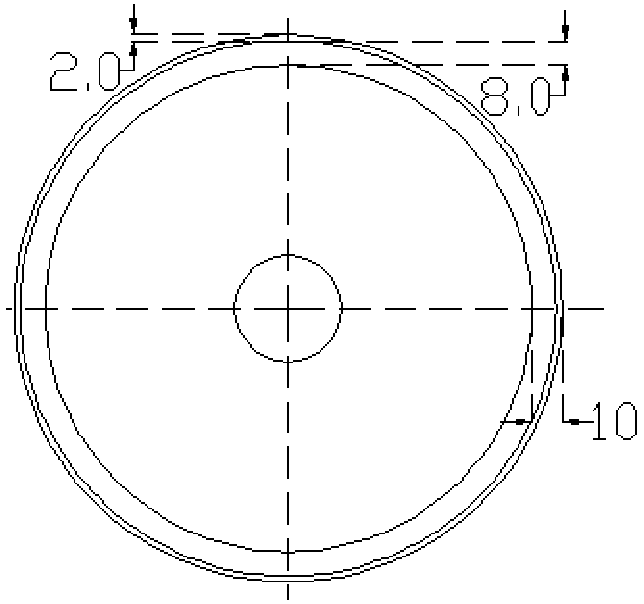




Step 3: To draw slots:

Offset the outer dia of rotor by 10mm inwards (slot dia = 1cm = 10mm) as shown above

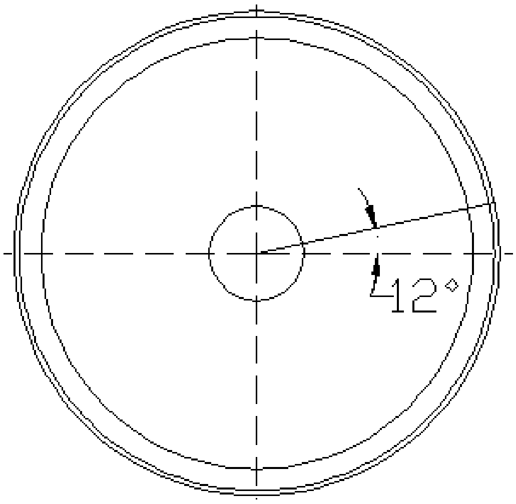
Again offset the outer dia of rotor by 2mm inwards to include depth of slot opening

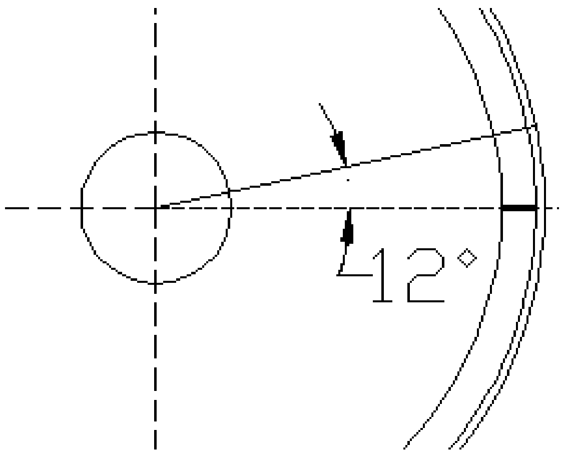


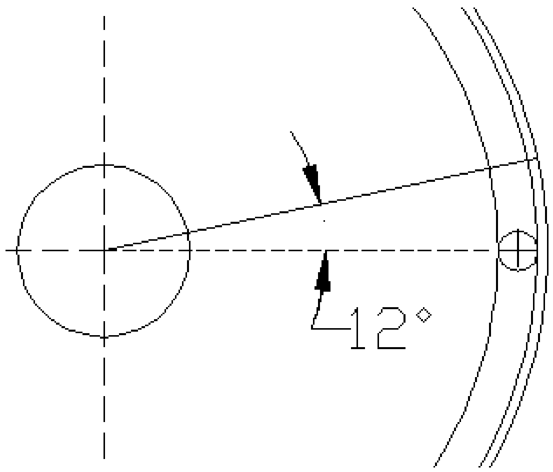
Slot angle is 12˚

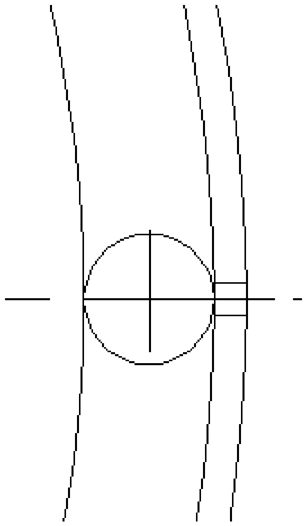
Draw a line from center of circle @180/2<12˚ = @90<12˚

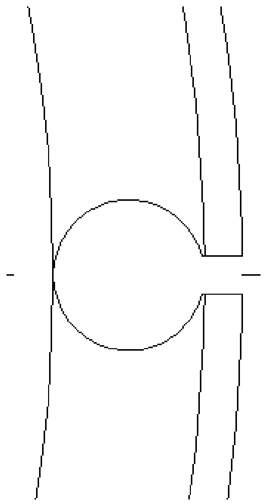
- Redraw the line ab and draw a vertical line at midpoint of ab
- On the line ab with ‘o’ as center draw a circle of dia 8mm
- To include width of slot opening as 2mm- Redraw line bc and offset it by 1mm on either of the sides as shown



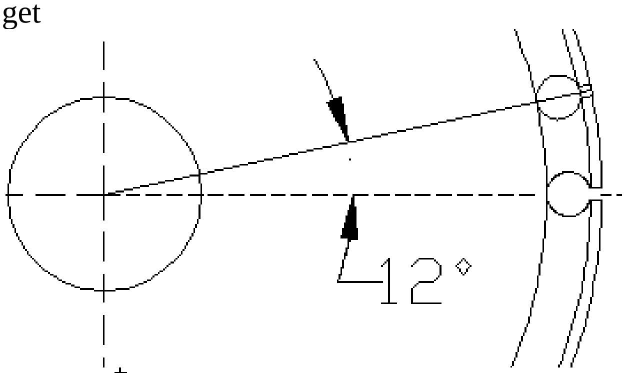


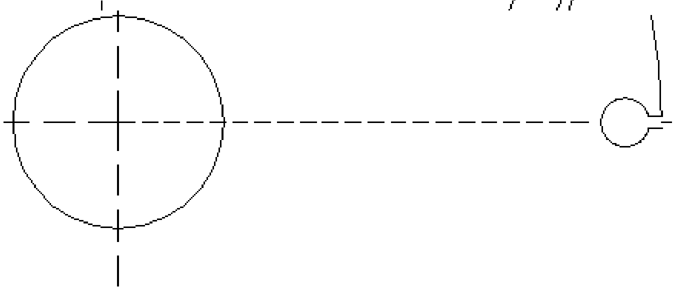






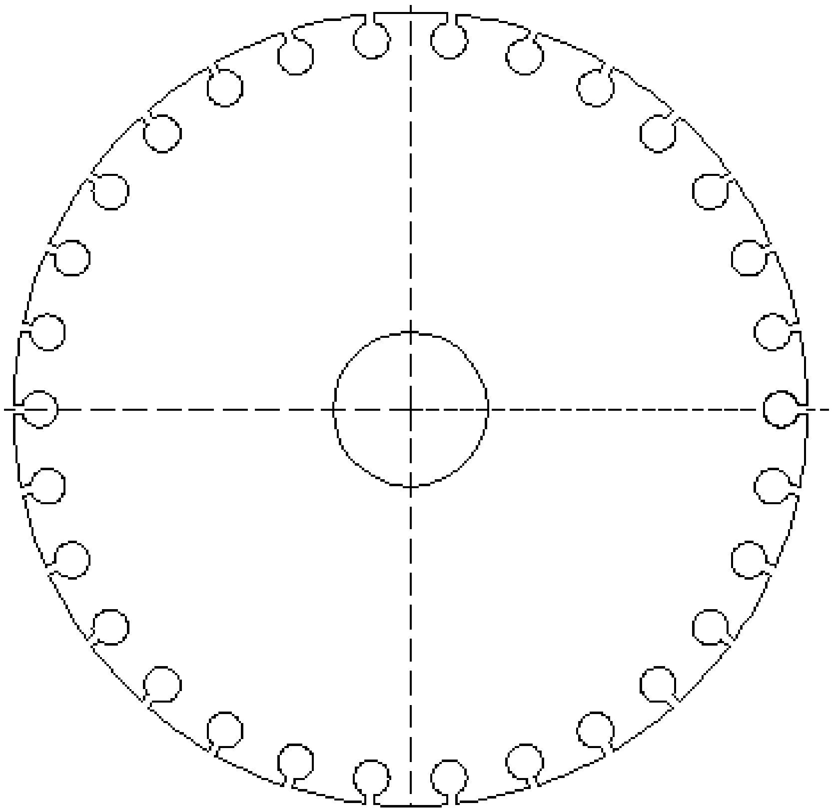
Polar array the slot:
No of items = 2 >> angle to fill = 12˚ >> specify center point >> select object >> OK….. we get





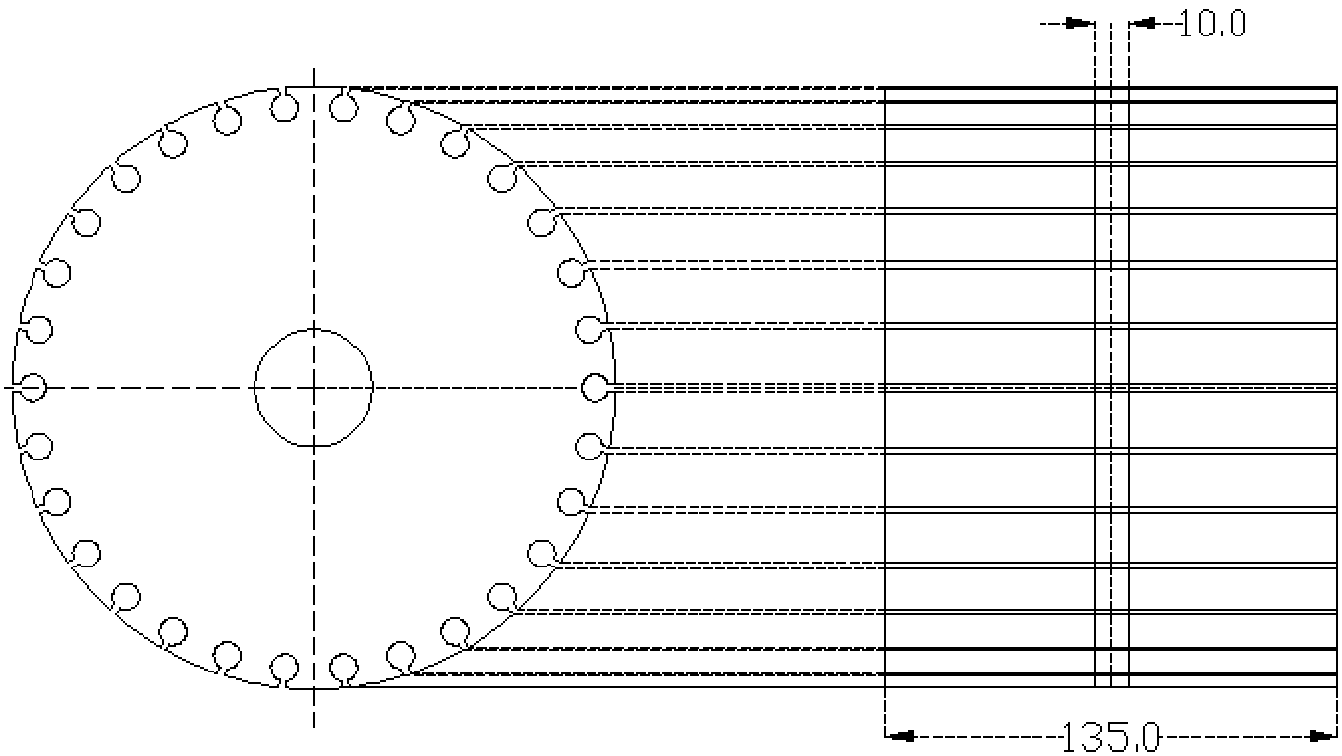
After polar array **After Trim**

Again polar array the slot :
No of items – 30 >> angle to fill – 360 >> specify the center point >>select object >> OK, we get



Step 4:

- Project the lines for elevation as shown
- Draw a line of dimension @135mm< 0˚(since length of rotor is given as 13.5cm)



Problem 3:

The rotor of an alternator consists of a shaft, a spider and poles.
Draw the half sectional end view of the rotor assembly with the following dimensions.
Scale = ½ full size.

1. **Shaft : It is made of mild steel and solid circular radius of the shaft = 3cms**
2. **Spider : It is made of cast steel and has four dovetail slots at its outer surface. The angle between the center line of the slots is 90. The spider is a square of sides 20cms.**

Distance between the center of the shaft and bottom of the dovetail slot = 8cms
Height of the dovetail size of slot plate = 6 * 2 cms
Width of the dovetail slot at the bottom = 5cms
Width of the dovetail slot at the top = 2.5cms
On both the sides of dovetail slot there is a hole of diameter = 0.5cms for fixing the retaining plate to the spider.

3. **Pole core: It is made of sheet steel laminations and they are fixed rigidly by suitable nuts and bolts at regular intervals.**

Height of the dovetail in the pole core = 2cm
Height of the core above dovetail = 8cm
Width of pole core = 10 cms
Width of pole face = 5 cms
Radius of pole arc at the top of the pole face from the center of the shaft = 20cms

4. **Pole winding : Made of enameled wire and suitably insulated. Height of pole winding = 8cms**

Width of pole winding = 15cms
Insulation between core and winding = 0.2cms

Solution:

1. **Shaft :** Radius = 3cm = 30mm

2. **Spider :**

3. **Dovetail details**:

Width of dovetail slot at top = 2.5cm
Width of dovetail slot at bottom = 5cm

4. **Pole details**:

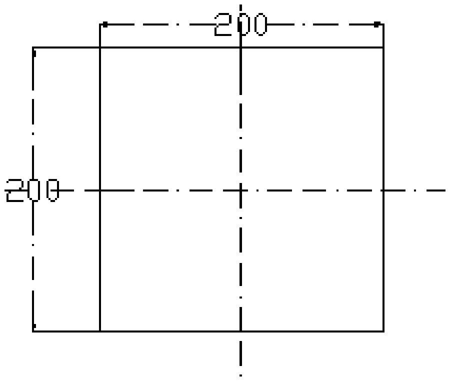
- Pole height without shoes = 8cm
- Width of pole = 10cm
- Radius of pole arc = 20cm

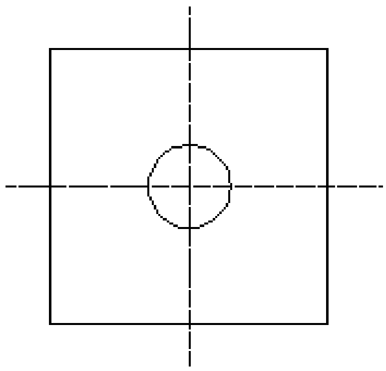
5. **Pole winding details:**

- Width of pole winding = 15cm
- Insulation between core and winding = 0.2cm
- Exclude dovetail plate details for full section

Step 1 : Units – Millimeter
Set limits: Limits: left corner 0,0 >> right corner : 1500,1500 >> zoom >> all
Step 2 : Draw a square of dimension 20cms = 200mm using rectangle command

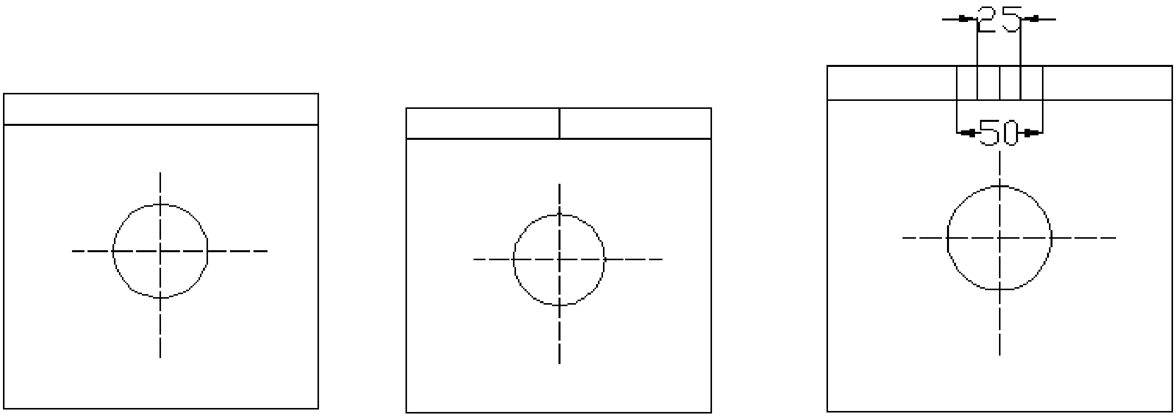
- Specify 1st point
- Next type 'd' in command line
- Next specify the length and width for rectangle as 200mm
- Draw horizontal and vertical reference lines using midpoint



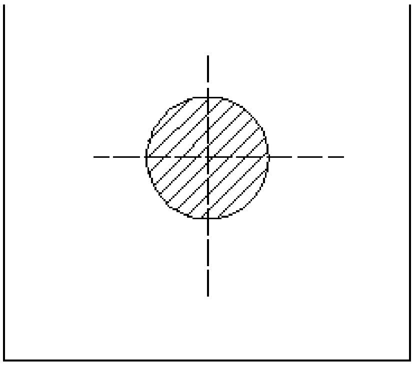


Step 3 : Draw a shaft of radius 30mm at center point as shown above
Step 4: To draw dovetail :

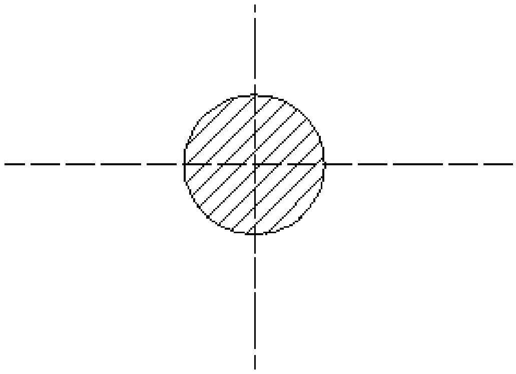
- Redraw the line 'ab' and offset it by 20mm



- Offset vertical line ‘cd’ by: 25/2 = 12.5mm on both sides (top width)
  50/2 = 25mm on both sides (bottom width) as shown above
- Join ‘ef ’ and join ‘gh’
- Trim the lines to obtain slot



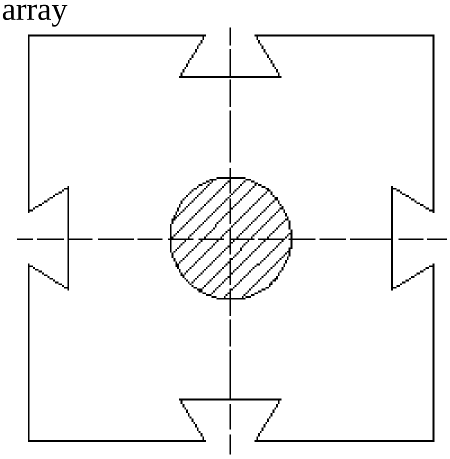
After trim:



- Polar array the dovetail:

No of items – 4 >> angle to fill – 360 >> select object >> OK

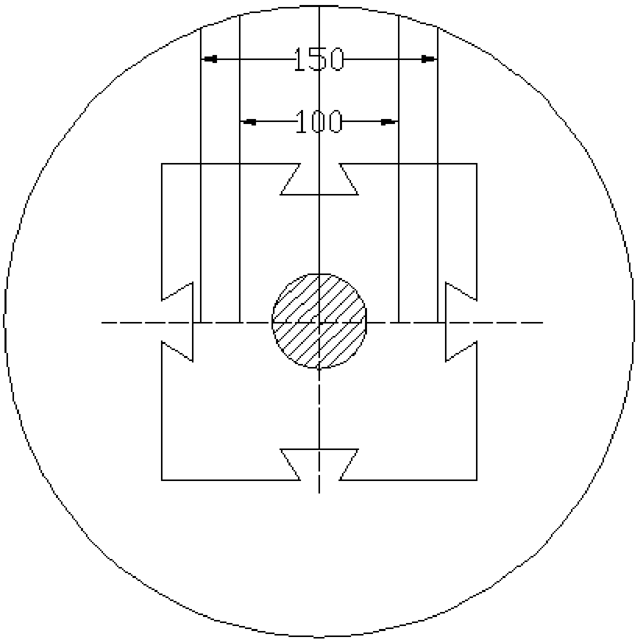
- Resultant of polar array

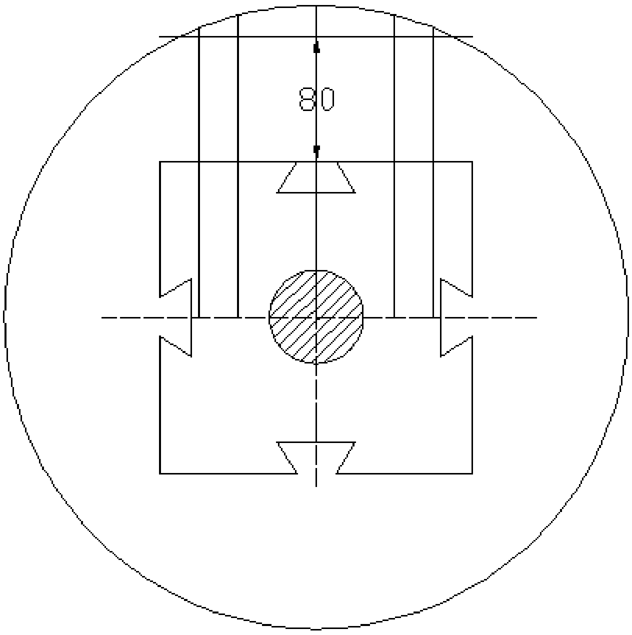


Step5: To draw pole core and winding

- Draw a circle of radius 200mm(given radius of pole arc = 20cm = 200mm)
  Pole core width = 10cm
  Pole winding width = 15cm
- Offset vertical line ‘mn’ by: 10cm/2 = 5cm = 50mm both sides

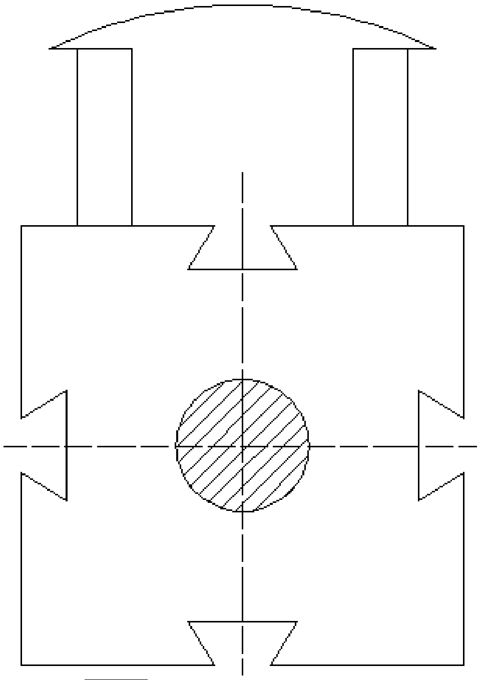
15cm/2 = 7.5cm = 75mm both sides

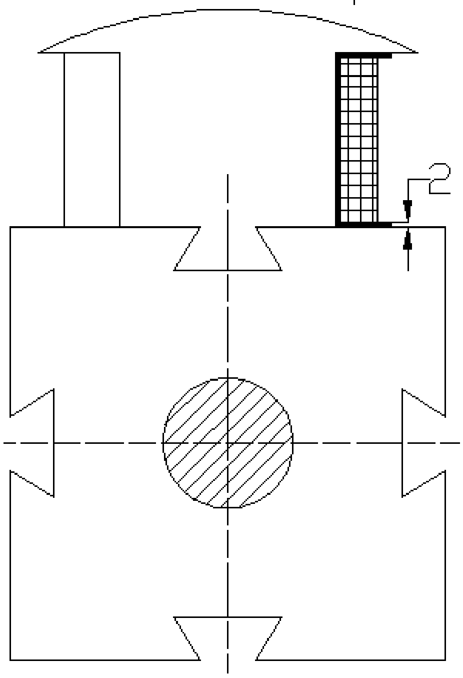




- Height of pole core above dovetail = 8cm
    - ✓ Redraw line ‘ab’
    - ✓ Offset the horizontal line ‘ab’ by 80mm above
    - ✓ Trim the lines to obtain pole core and field windings as shown above

After trim we get,





Provide 2mm thickness of insulation on all 3 sides as shown above

Mirror the pole winding on other side
Polar array the entire pole core with pole winding:
No of items – 4 >> angle to fill = 360 >> specify center point >> OK

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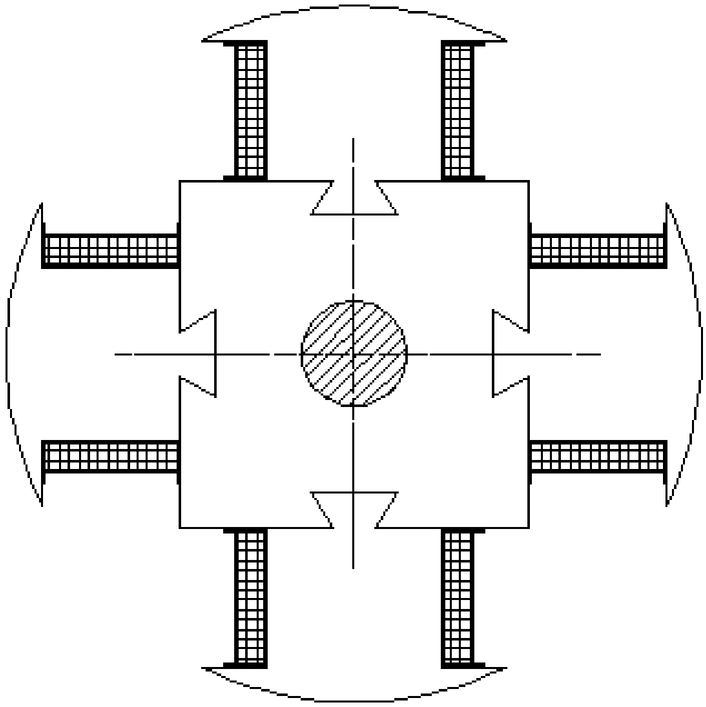

Draw the half section end view and half section elevation of the squirrel cage rotor directly mounted over the shaft. Show clearly the method of fixing the rotor with the shaft.

Rotor outside diameter	=17.88cm
Number of slots	=31
Size of slots (circular) dia	=1cm
Slot opening	=2mm
Length of rotor	=13.5cm
One radial cooling duct	=1cm wide
Dia of shaft below rotor stamping	=3.5cm

- Follow the same steps to draw the rotor outside diameter
- Draw one slot of 1cm dia
- Use polar array option to draw other 30 slots as explained in the above problem
- Elevate the half section of the squirrel cage rotor.

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Draw the half sectional end view of the rotor assembly with the following dimensions.

1. Shaft: it is made of mild steel and solid circular radius of the shaft =3cms
2. Spider: it is made of cast steel and has four dovetail slots at its outer surface. The angle between the center lines of the slots is 90. The spider is a square of sides 20 cms.
   Distance between the center of the shaft and bottom of the dovetail slot=8cms
   Height of the dovetail size of slot plate=6*2 cm
   Width of the dovetail slot at the bottom=5cm
   Width of the dovetail slot at the top=2.5cm
   On both side of the dovetail slot there is a hole of dia=0.5cm
3. Pole core: it is made up of sheet steel laminations and they are fixed rigidly by suitable bolts and nuts at regular intervals
   Height of the dovetail in the pole core=2cms
   Height of the core above dovetail =7cms
   Width of the pole core= 10cms
   Width of the pole face= 10cms
   Radius of the pole arc at the top of the pole face from the center of the shaft=20cms
4. Pole winding: Made of enameled wire and suitably insulated. height of pole winding=8cms
   Width of pole winding=15cms
   insulation between core and winding=0.2cms.

Outcome: students will be able to draw and visualize sectional views of stator and rotor