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WELCOME

TO Adda247

"There is nothing impossible to they who will try."


GATE 2024
GATE
प्रचण्ड Batch
PRODUCTION
METAL CUTTING
LEC-7
Mechanical Engineering

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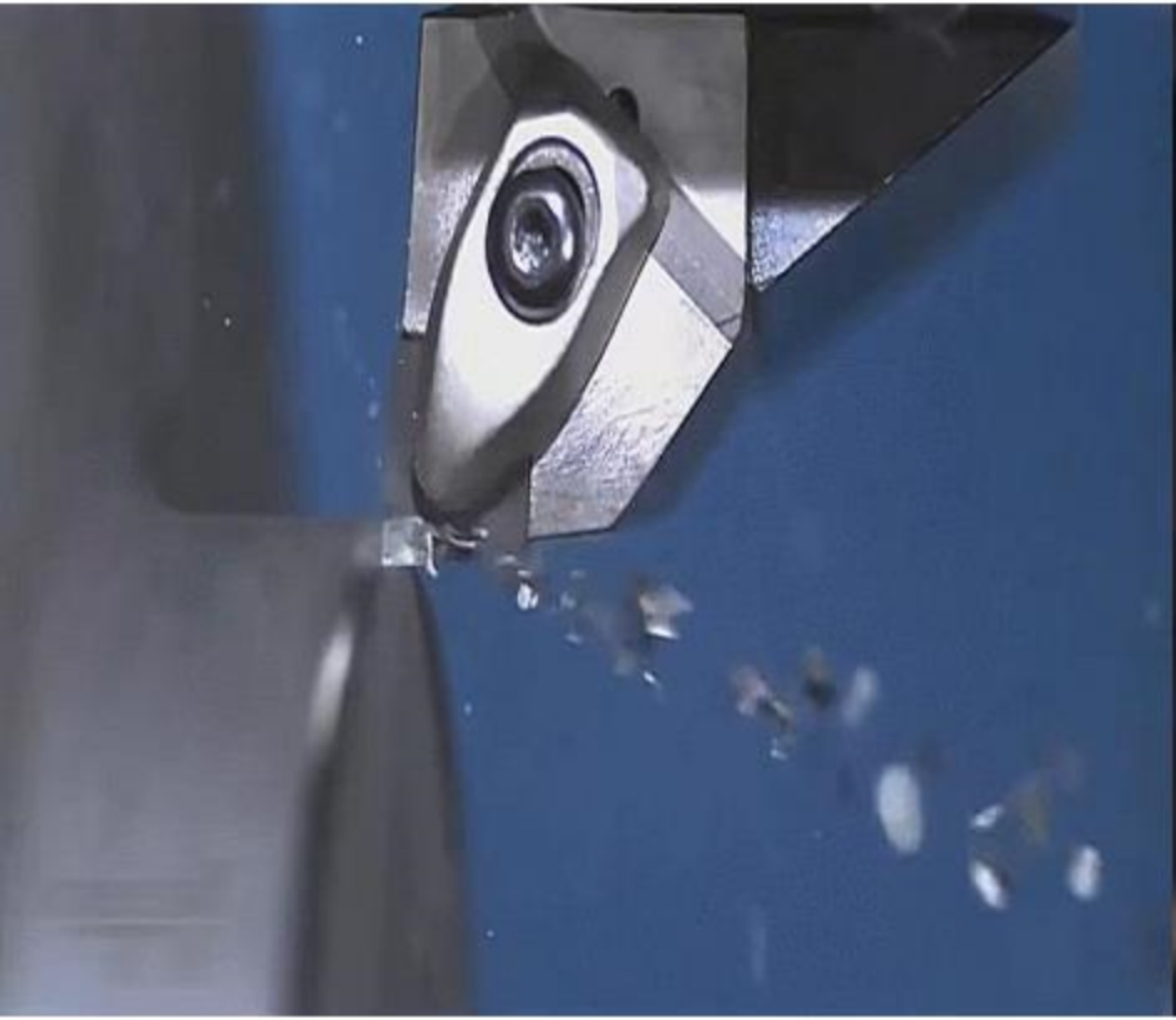
METAL CUTTING



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1.Itroduction to Metal cutting

2.Machining operation

3.Turning operation And analysis

4 .Orthogonal Machining Analysis

5 .Side cutting edge angle And end cutting edge angle

6.Nose Radius

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7.Shear Angle

8.Velocity in Metal cutting

9.Cutting shear strain

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1.Shear strain Rate

2.Force Analysis of Metal cutting

3.Merchant circle Diagram

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Shear strain Rate ($\dot{\varepsilon}$)

* It is Not a Shear Strain
* It is Rate of Shear Strain i.e Flow

* $V_s \rightarrow$ Shear velocity
* $t_s \rightarrow$ Thickness of Shear zone

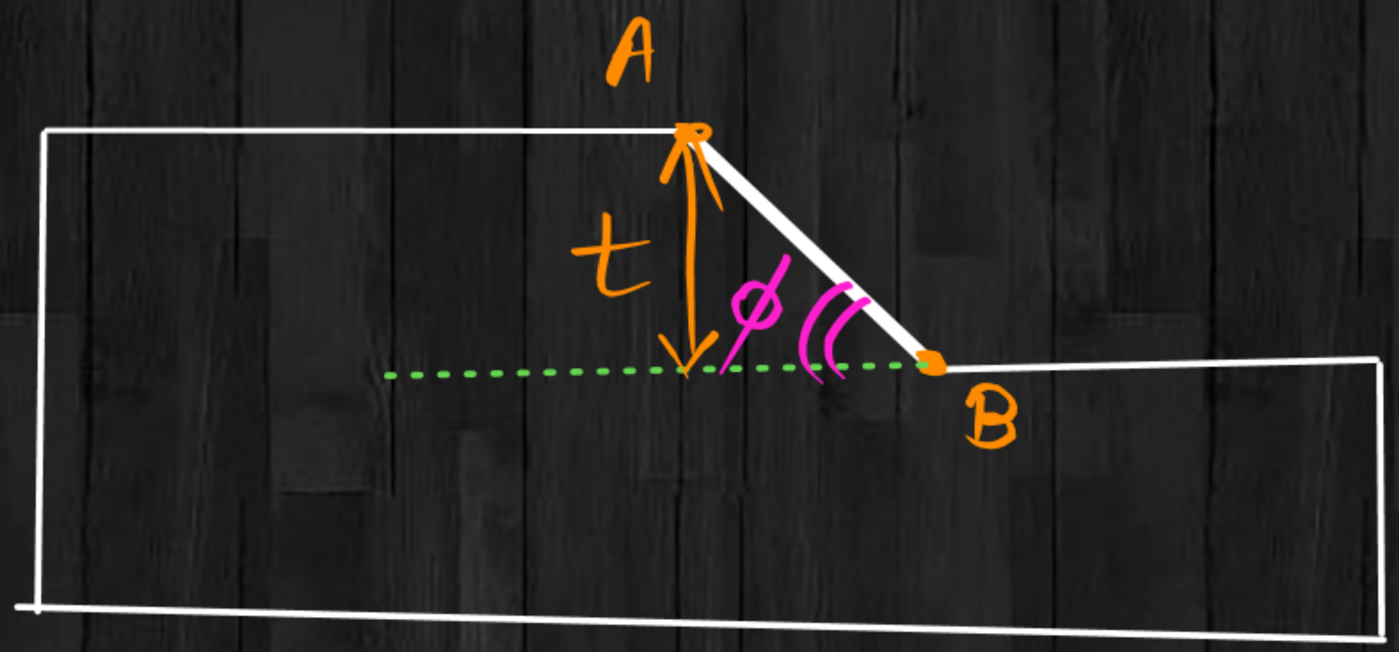
* $$\dot{\varepsilon} = \frac{d\varepsilon}{dt} = \frac{V_s}{\text{Thickness of Shear zone}}$$

* $$\dot{\varepsilon} = \frac{V_s}{t_s}$$

$V_s \rightarrow$ mm/s, $t_s \rightarrow$ mm $\Rightarrow \left(\frac{1}{sec}\right)$

* AB → Shear plane

* t_s → 10% of Shear Plane Length
Max 25 Micron



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Given Data :→ Orthogonal

* $r = 0.4$
* $t = 0.6\,mm$
* $\alpha = 10^\circ$
* $V = 2.5\,m/s$
* $t_s = 25\,\mu m = 25 \times 10^{-6}\,m$
* $\dot{\varepsilon} \rightarrow (s^{-1}) = ?$

Q. Details pertaining to an orthogonal metal cutting process are given below.

Chip thickness ratio	0.4
Undeformed thickness	0.6 mm
Rake angle	$+10^\circ$
Cutting speed	2.5 m/s

Mean thickness of primary shear zone 25 microns

The shear strain rate in s^{-1} during the process is

(a) 0.1781×10^5
(b) 0.7754×10^5
(c) 1.0104×10^5 ✓
(d) 4.397×10^5

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Solution :→

* $\dot{\varepsilon} = \dfrac{V_s}{t_s}$

* $\dot{\varepsilon} = \dfrac{2.526 \text{ m/s}}{25 \times 10^{-6} \text{ m}}$

* $\dot{\varepsilon} = 1.0104 \times 10^{5} \text{ m/s}$

(ii) * $\dfrac{V_s}{V} = \dfrac{\cos\alpha}{\cos(\phi - \alpha)}$

* $V_s = \dfrac{\cos\alpha \times V}{\cos(\phi - \alpha)} \Rightarrow \dfrac{\cos 10 \times 2.5}{}$

* $V_s = \dfrac{\cos 10 \times 2.5}{\cos(22.94 - 10)}$

* $V_s = 2.526 \text{ m/s}$

* $\tan\phi = \dfrac{r \cdot \cos\alpha}{1 - r \cdot \sin\alpha}$

* $\tan\phi = \dfrac{0.4 \times \cos 10}{1 - 0.4 \cdot \sin 10}$

* $\phi = 22.94^\circ$

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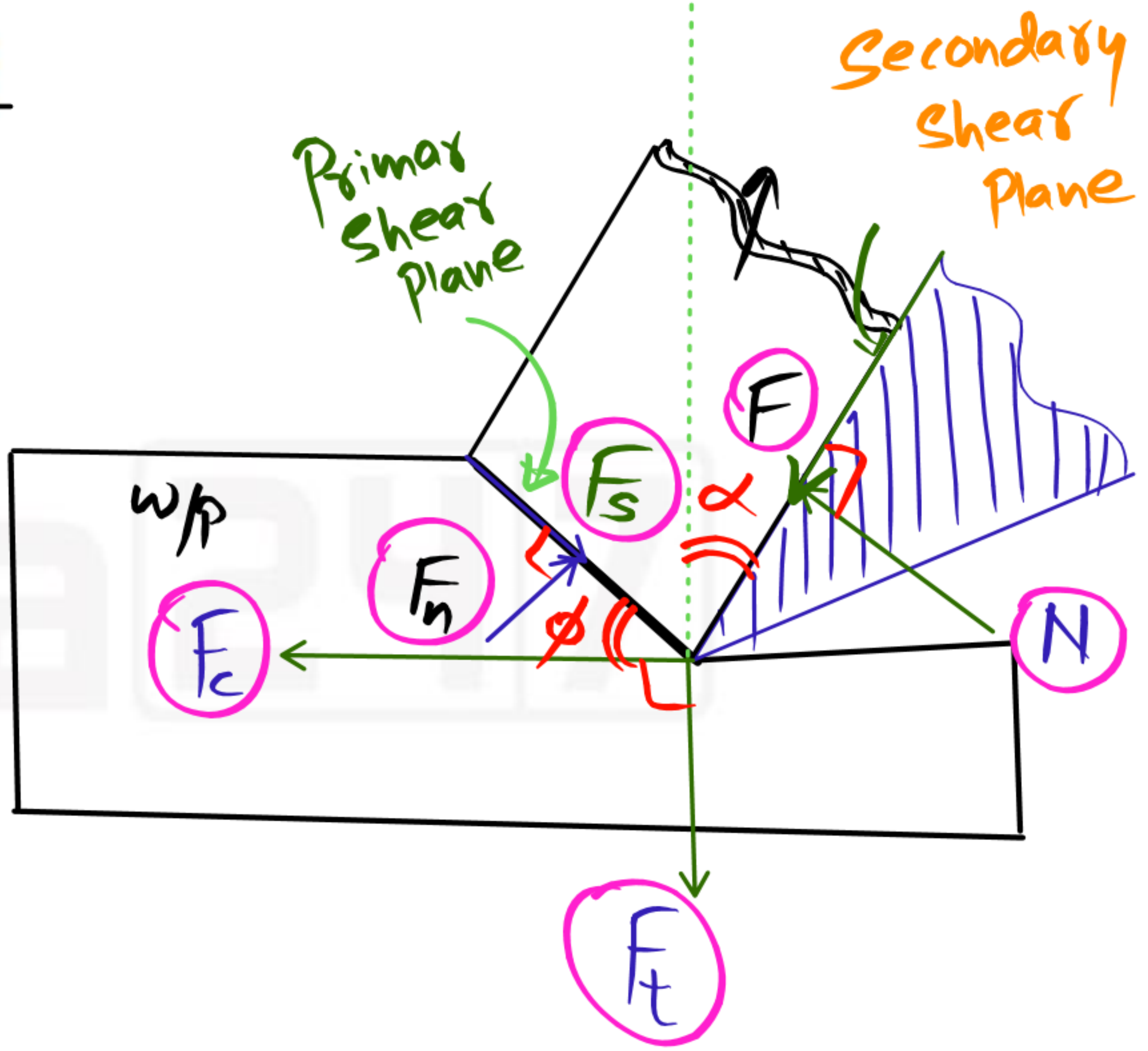
Force Analysis of Metal cutting

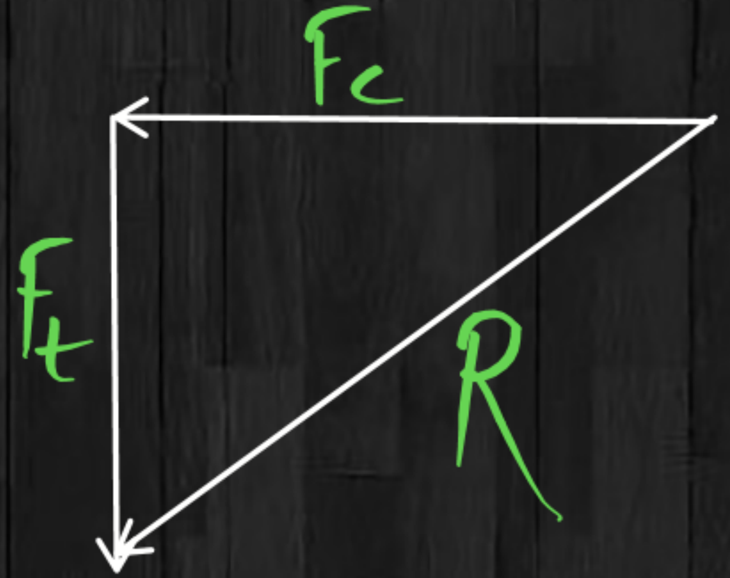
* F_c → cutting force
* F_t → Thrust force
* F → Frictional Force at chip- Tool Interface
* N → Normal force at chip- tool interface
* F_s → Shear force
* F_n → Normal force on Shear Plane



* $F_c \perp F_t$ $\Longrightarrow$ Measured by "Dynamometer" (Known)

* $F \perp N$
* $F_s \perp F_n$

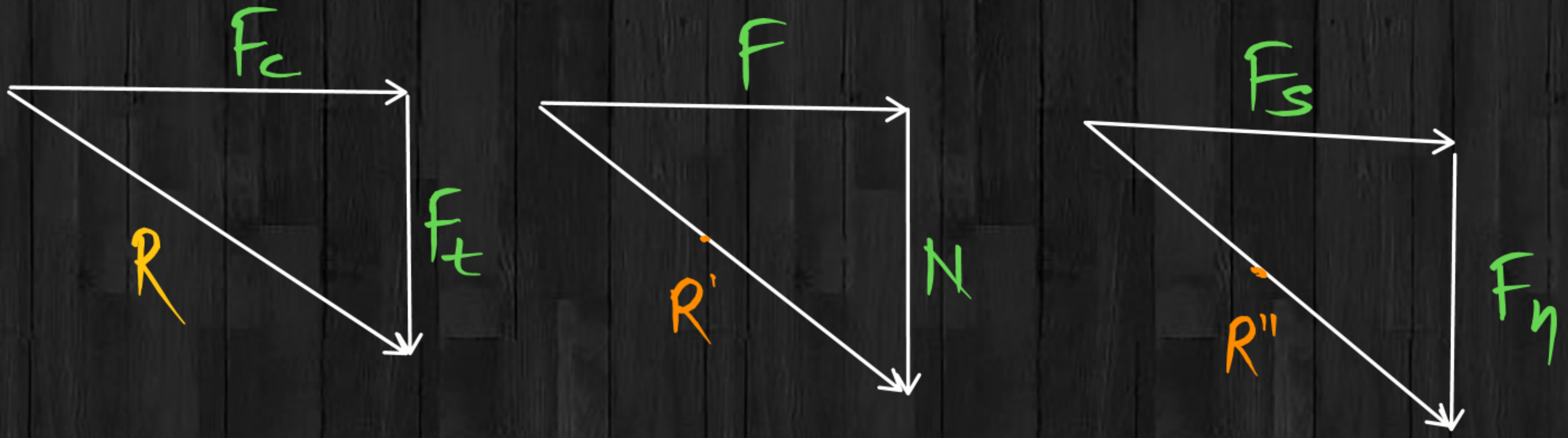
} $\Rightarrow$ Unknown



* $R = \sqrt{F_c^2 + F_t^2}$

$\downarrow$

Known



* $R = \sqrt{F_c^2 + F_t^2}$

* R' → unknown , R'' → unknown

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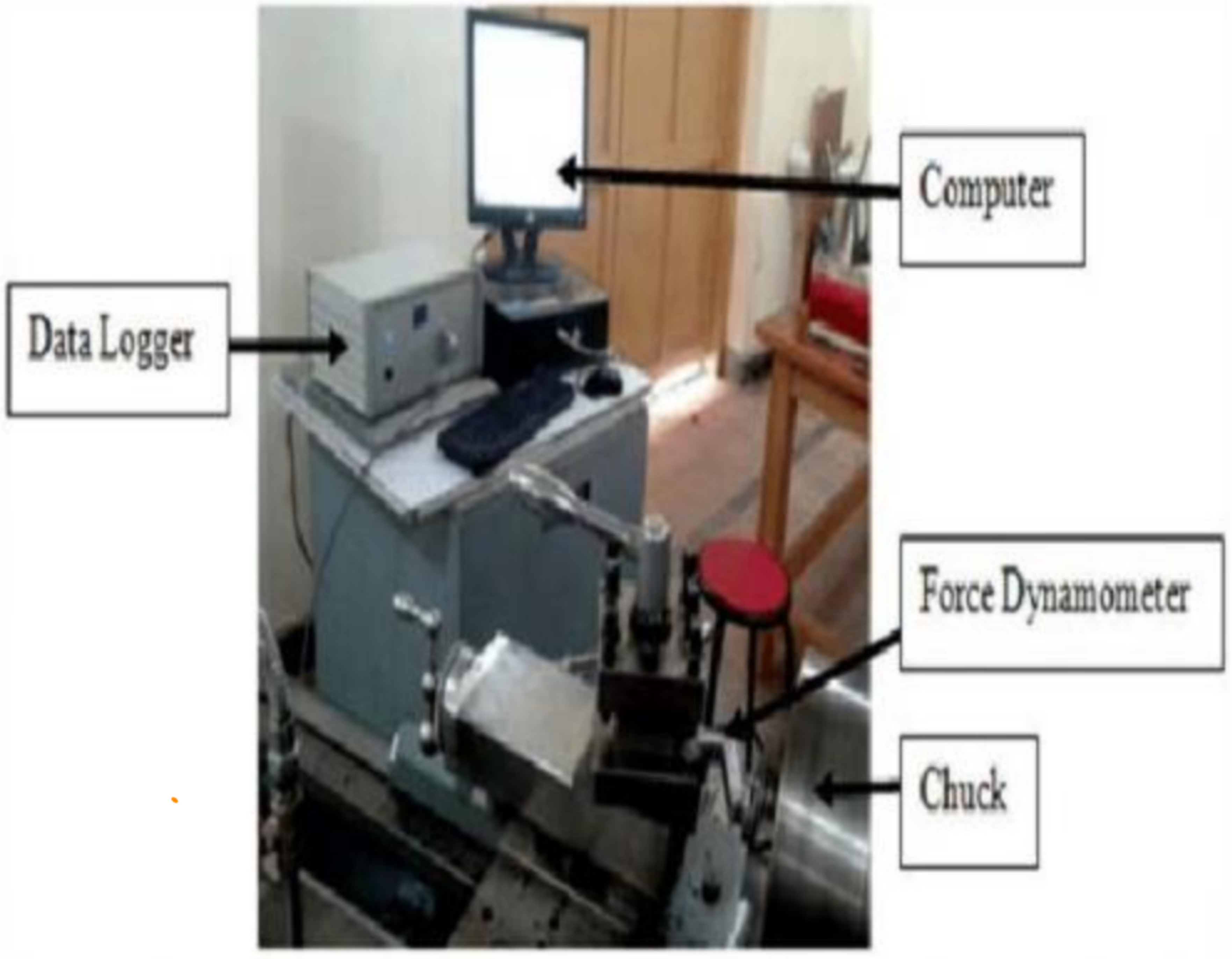

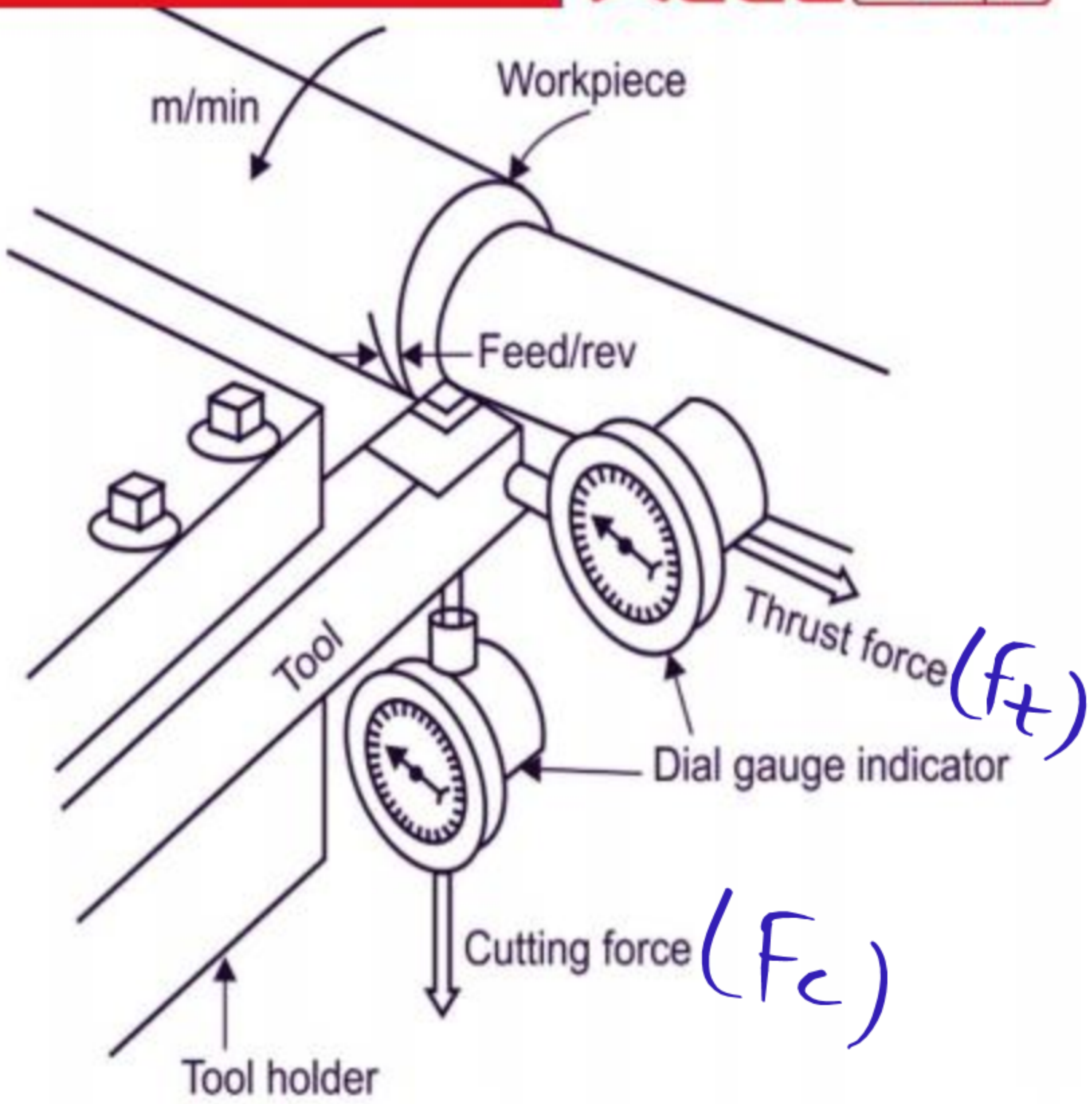

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Merchant Force circle Diagram (MCD) *****

* $\beta \rightarrow$ Friction Angle

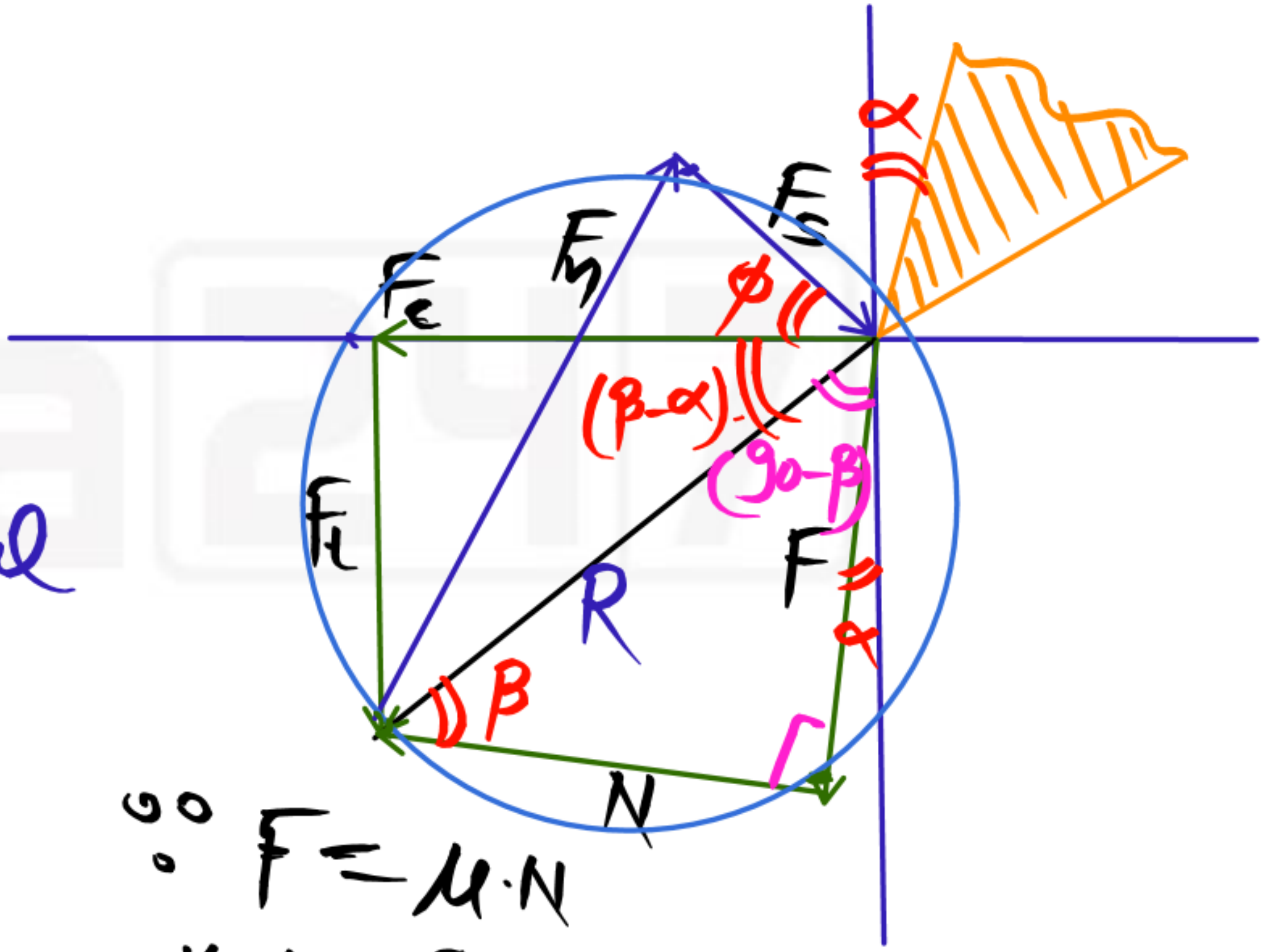
* $x + \cancel{90} - \beta + \alpha = \cancel{90}$

* $x = \beta - \alpha$

* Merchant ⇒ circle ⇒ orthogonal cutting

* $\tan\beta = \frac{F}{N} \Rightarrow \mu$

* $\tan\beta = \mu$



∴ $F = \mu \cdot N$

* $\mu = \frac{F}{N}$

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* $\tan\beta = \mu$

* $\beta = \tan^{-1}(\mu)$

* $\sin\beta = \frac{F}{R}$

* $F = R \cdot \sin\beta$

* $\cos\beta = \frac{N}{R}$

* $N = R \cdot \cos\beta$

* $F_c = R \cdot \cos(\beta - \alpha)$

* $F_t = R \cdot \sin(\beta - \alpha)$

* $F_s = R \cdot \cos(\phi + \beta - \alpha)$

* $F_n = R \cdot \sin(\phi + \beta - \alpha)$

$R = ?$

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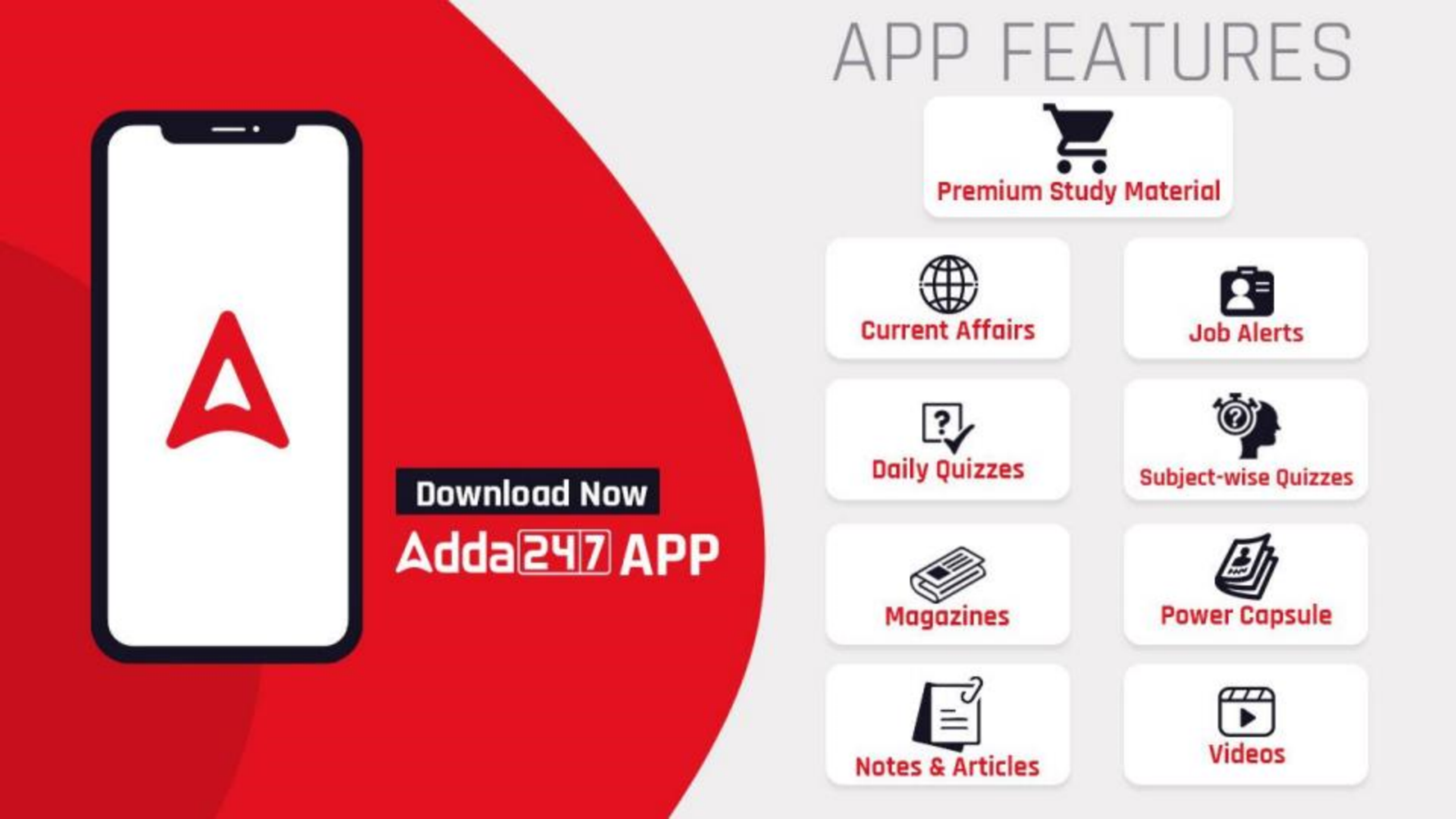
BARC 2023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