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"If you can think, you can Achieve"
So start thinking..

Renu Raj Garg
M.Tech (VLSI Design)
13 Year of Teaching Experience
Worked 10 Year in NTRO

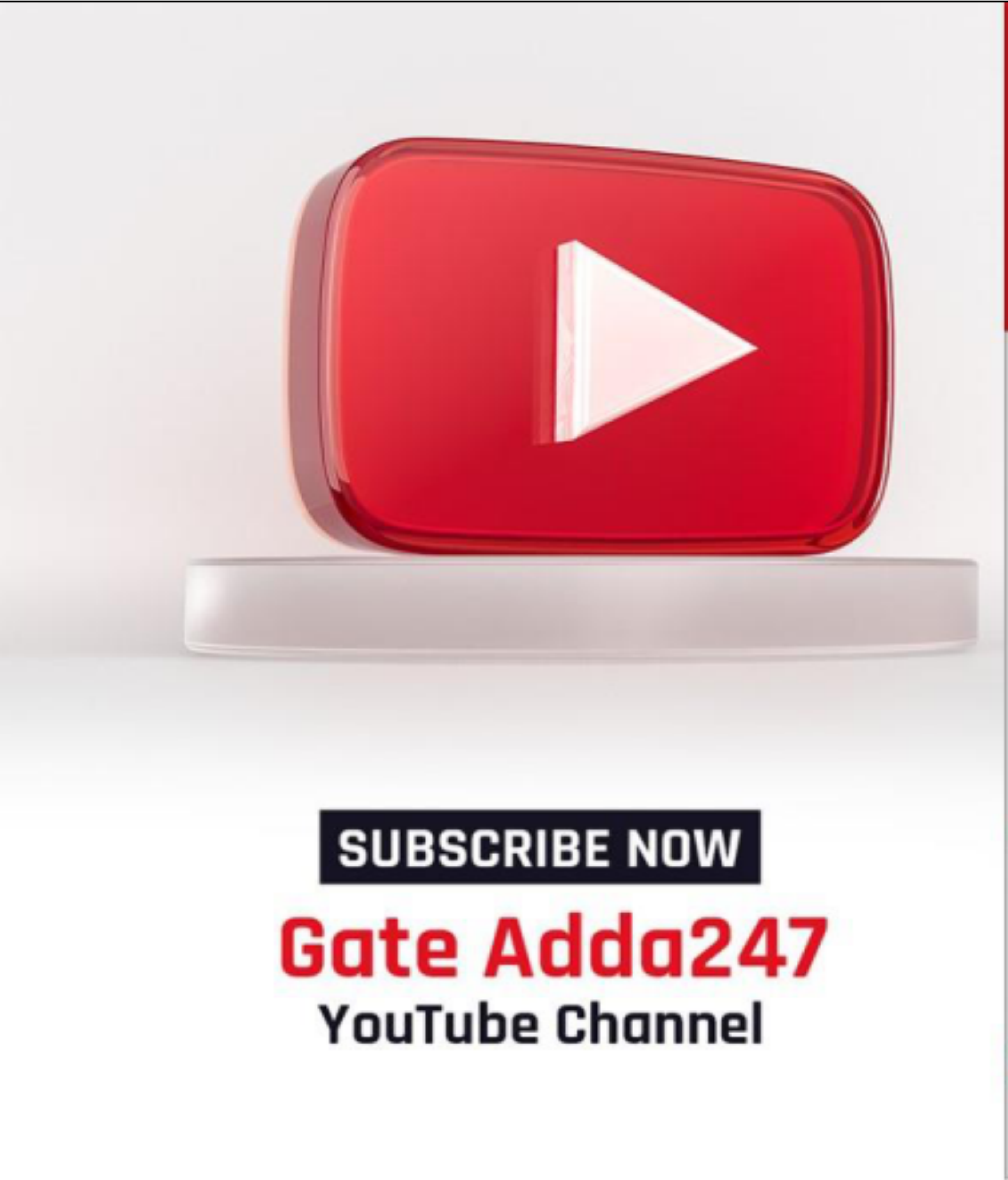

GATE 2024
GATE
प्रचण्ड Batch
COMMUNICATION
TIME DIVISION MULTIPLEXING (TDM}
LIVE @ 9:00PM
RENU SIR

Chapter-2

Digital Communications

In today's lecture we will cover the following Topis :

1. *Time Division Multiplexing (TDM)*



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AIR 217 ME VISHAL KUMAR
AIR 219 ME NITISH KUMAR
AIR 258 EE MANAV
AIR 348 EE AMAN NAMDEV
AIR 392 EE GAURAV MAHAJAN
AIR 403 EC MOHAN KUMAR SINGH
AIR 567 EE SHANKAR JHA
AIR 571 ME VIJENDER MEENA

Use Code Y505 | Communications for GATE 2024

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YouTube Classes Schedule

ENGINEERS

EE & EC ENGINEERING

EXAM TARGET	SUBJECT	TIME	FACULTY
ALL PSUs	ENGINEERING MATHS	11:00 AM	ANANT SIR
GATE 2024-25	NETWORK THEORY	6:00 PM	RAVI SIR
GATE 2024-25	ELECTRICAL MACHINE	7:30 PM	SANTAN SIR
GATE 2024-25	COMMUNICATION	9:00 PM	RENU SIR

FREE APP CLASS SCHEDULE

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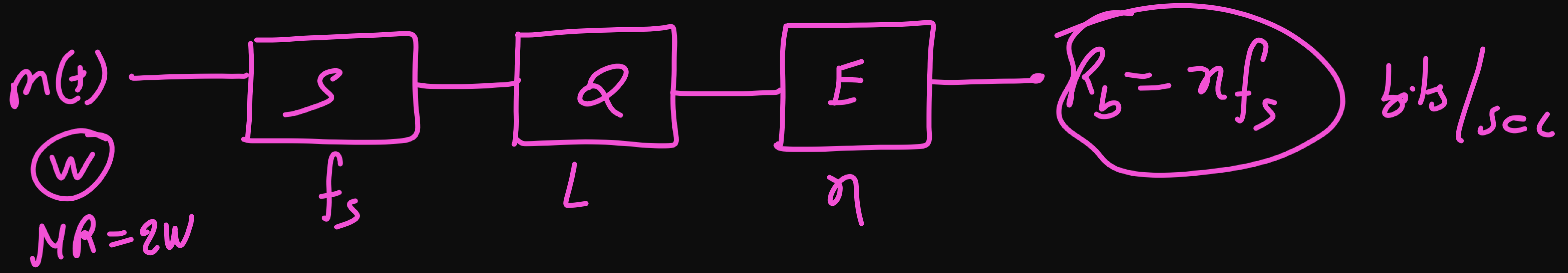
GATE

NETWORK THEORY	SATURDAY Live @11AM	RAVI SIR
COMMUNICATION	WEDNESDAY Live @8PM	RENU SIR
ANALOG ELECTRONICS	THURSDAY Live @8PM	LAWRENCE SIR
ENGINEERING MATHEMATICS	FRIDAY Live @11AM	ANANT SIR
ELECTRICAL MACHINE	MONDAY Live @8PM	SANTAN SIR

Time Division Multiplexing (TDM)

Analog Comm. → FDM

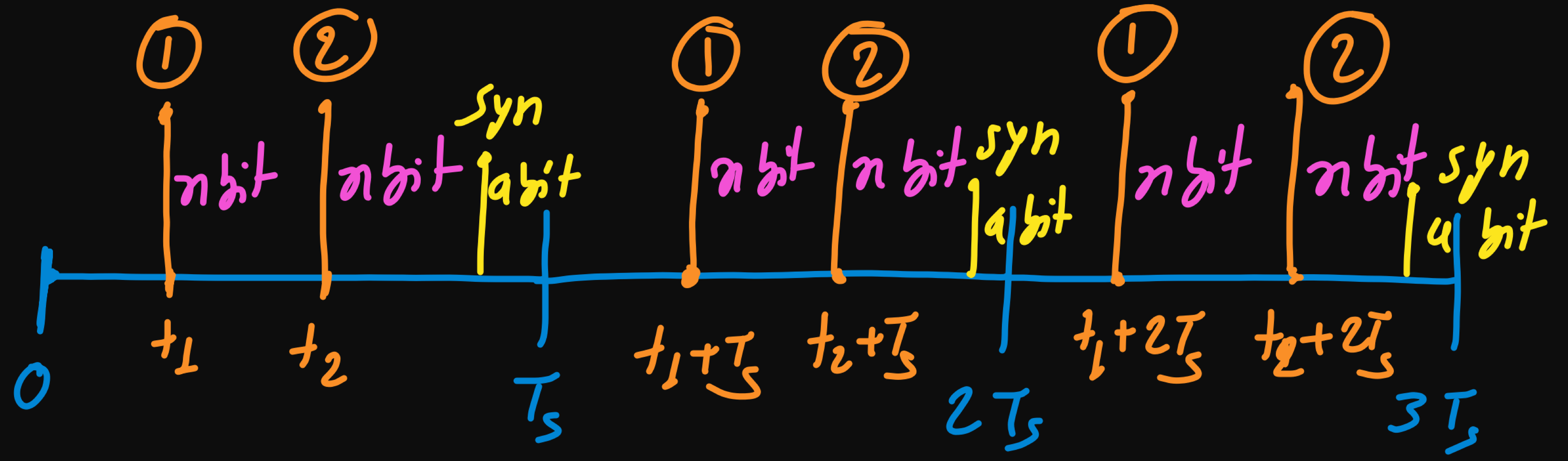
Digital Comm → TDM



TDM

$$R_b = K n f_s$$

↓ no. of msg

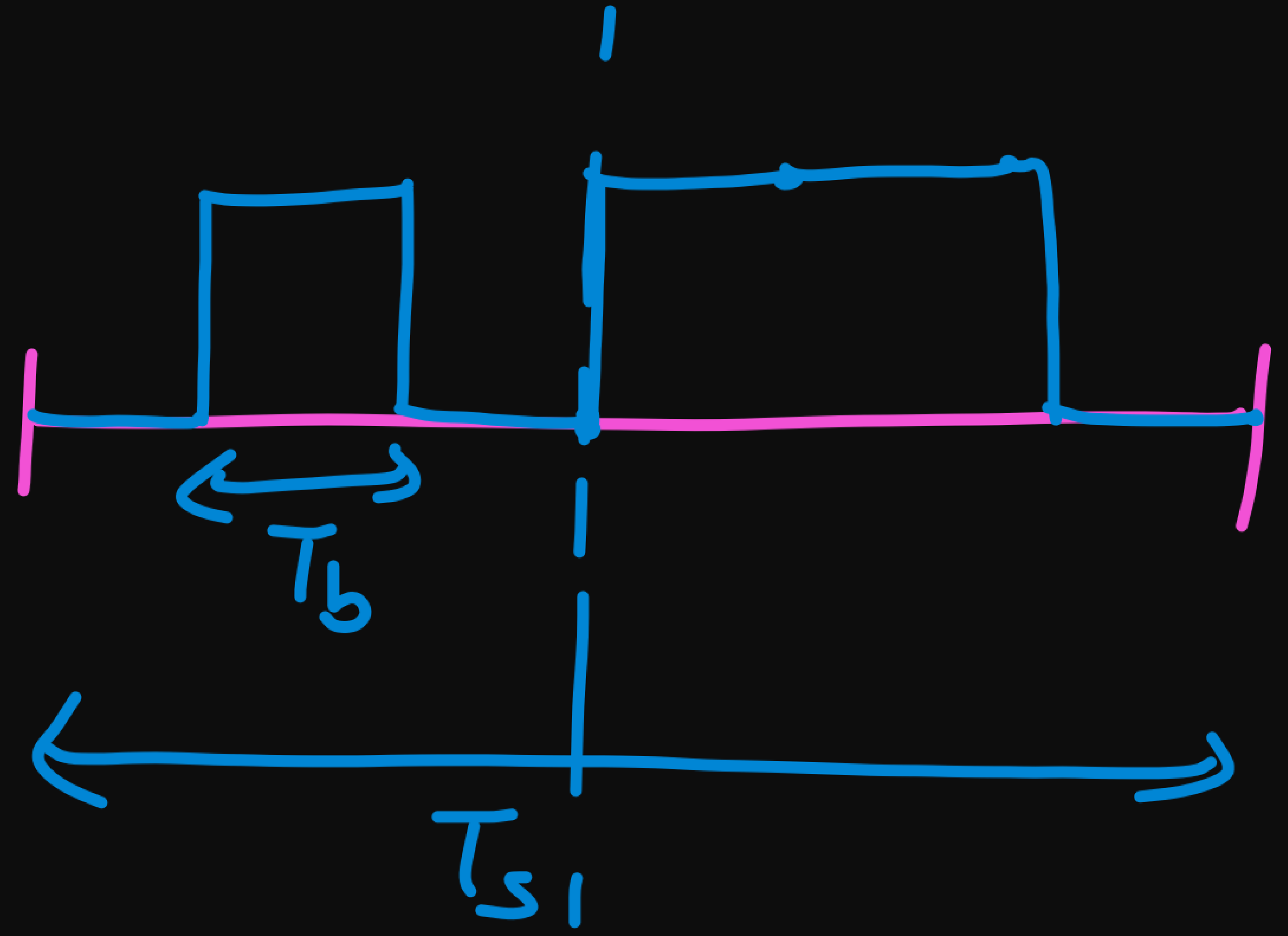


$T_s = 2n\,T_b$

↓

no. of msg signal $= K$

$T_s = K \cdot n\,T_b \Rightarrow R_b = K n f_s$



$T_s = 6\,T_b$

If Synchronization is present:

$$T_s = (nK + a)\, T_b \longrightarrow R_b = (nK + a) f_s$$

$$R_b = (Kn + a) f_s$$

K = no. of msg

n = n-bit Encoder

a = No. of syn. bit

↓

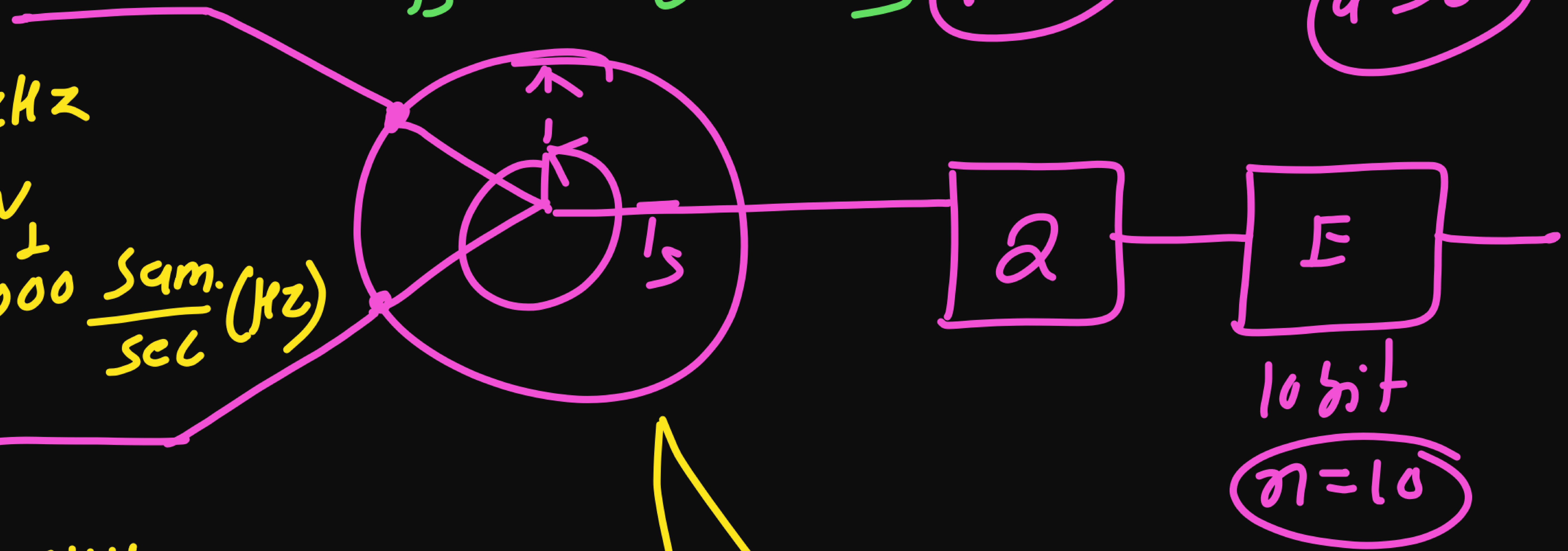
Cal. Best f_s

$f_s = \max[NR_1, NR_2]$ $k = 2$ $a = 0$ $(BW_T)_{min} = \frac{R_b}{2} = 30\,KHz$

$m_1(t)$

$W_1 = 1\,KHz$

$NR_1 = 2W_1 = 2000 \frac{sam.}{sec} (Hz)$



$m_2(t)$

$W_2 = 1.5\,KHz$

$NR_2 = 2W_2 = 3000 \frac{sam.}{sec} (Hz)$

$R_b = (kn + a) f_s$

$R_b = (2 \times 10 + 0) f_s$

$R_b = 20 f_s = 20 \times 3000$
$= 60\,kbps$

$f_s = 2000$ samples/sec → Aliasing Effect for msg (2)

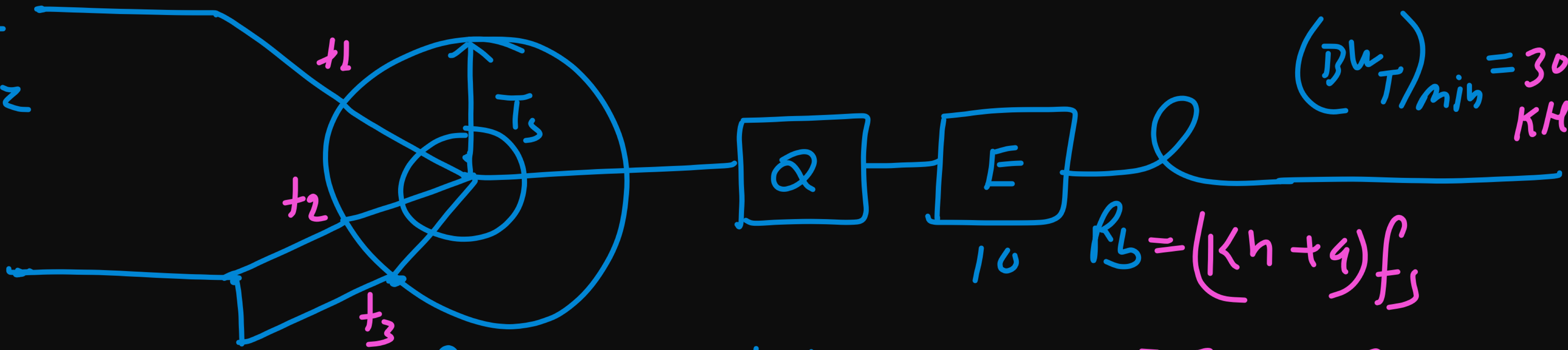
$f_s = 3000$ samples/sec → Excess BW for msg (1)

Case (ii) if $f_s = 2000 \frac{\text{sample}}{\text{sec}}$

$K=3,\ n=10,\ q=0$

$m_1(t)$
$W_1 = 1\,KHz$
$NR_1 = 2\,KHz$

$m_2(t)$
$W_2 = 1.5\,KHz$
$NR_2 = 3\,KHz$



$(BW_T)_{min} = 30\,KHz$

$R_b = (Kn+q) f_s$

$= 3 \times 10 \times 2000$

$= 60\,Kbps$

$f_s = 2000$ sample/sec

Excess BW for msg (2)

Case (iii) best f_s → We will not use excess BW for any msg.

$f_s = 1000$ samples/sec

$K = 5$ $n = 10$ $q = 0$

$R_b = (Kn + q) f_s$

$= 5 \times 10 \times 1000$

$= 50$ Kbps

Que. If we have 5 msg of BW W, W, 2W, 3W, 4W → (KHz) min Xmission BW req. to Xmit this signal by TDM. (n = 1)

min bit Rate so that Xmission BW should be min.

$R_b \rightarrow$ Kbps

$(BW_T)_{min} = \frac{R_b}{2}$ (KHz)

$W \rightarrow MR_1 = 2W$

$W \rightarrow MR_2 = 2W$

$2W \rightarrow MR_3 = 4W$

$3W \rightarrow MR_4 = 6W$

$4W \rightarrow MR_5 = 8W$

$f_s = 2W$

$K = 11$

$n = 1$

$R_b = Kn \cdot f_s$

$R_b = 11 \times 2W = 22W$

$R_b = 22W$ (KHz)

$(BW_T)_{min} = 11W$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