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TALLINNA TEHNIKAÜLIKOOL

TALLINN UNIVERSITY OF TECHNOLOGY

# Testimise projekteerimine

## Laborid

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# Laborid

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**BISTA**

**1. Understanding BIST** (6. nädal)

**2. BIST Optimizatsion** (10. nädal)

**Trainer**

**1149**

**3. Understanding Boundary Scan**  
(14. nädal)

**Cadence**

**BISTA**

**Turbotester**

**Kursuse töö (eksam)**

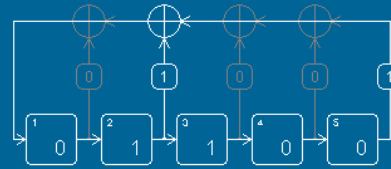
# BISTA (Built-in Self Test Analyser)

## BIST Technique Teaching Tool

The screenshot displays the BISTA Analyzer software interface. The main window is titled "BISTA Analyzer" and has tabs for "PRPG", "Algorithms", and "Charts". The "PRPG" tab is active, showing a configuration panel on the left and a diagram of a PRPG on the right.

**Configuration Panel (Left):**

- Buttons: Model, Chart, Reset, Save, RUN
- PRPG Type: Type I LFSR
- Feedbacks: 01001
- Seed: 01100
- Clock cycles to run: 20
- Detect Loops
- Show effective vectors
- Register length: 5
- Status: Model: c17.agm, inputs: 5
- History (Previous Experiments):
  - Mon Sep 22 14:23:17 EEST 2008 Pure\_PRPG
  - Mon Sep 22 14:24:41 EEST 2008 Pure\_PRPG
- Clear table



Characteristic Polynomial:  $x^5 + x^2 + 1$

Result Table

No.	+	%	v1	v2	v3	v4	v5
1.	13.636	13.636	0	1	1	0	0
2.	31.818	18.181	1	0	1	1	0
3.	45.454	27.272	0	1	0	1	1
4.	68.181	27.272	0	0	1	0	1
5.	68.181	13.636	1	0	0	1	0
6.	72.727	27.272	0	1	0	0	1
7.	72.727	22.727	0	0	1	0	0
8.	72.727	18.181	0	0	0	1	0
9.	72.727	27.272	0	0	0	0	1
10.	81.818	18.181	1	0	0	0	0
11.	81.818	18.181	0	1	0	0	0
12.	81.818	27.272	1	0	1	0	0
13.	81.818	27.272	0	1	0	1	0
14.	81.818	27.272	1	0	1	0	1
15.	81.818	22.727	1	1	0	1	0
16.	95.454	31.818	1	1	1	0	1
17.	100.0	31.818	0	1	1	1	0
18.	100.0	4.5454	1	0	1	1	1
19.	100.0	22.727	1	1	0	1	1
20.	100.0	18.181	0	1	1	0	1

# Trainer 1149

## Boundary Scan Technique Teaching Tool

The screenshot displays the Trainer 1149 software interface, which is used for teaching boundary scan techniques. The main window shows a circuit diagram with three components: BufferIN (SN74BCT8244A), D2 (02D2D803h), and BufferOUT (SN74BCT8244A). The BufferIN and BufferOUT are configured with BYPASS registers. The D2 component has an EXTEST register. The BufferIN and BufferOUT have registers set to 11111111. The BufferOUT has several bits highlighted in blue. The Diagnostic Results window at the bottom shows a grid of test results for 33 bits across 6 tests.

Tests	0 bit	1 bit	2 bit	3 bit	4 bit	5 bit	6 bit	7 bit	8 bit	9 bit	10 bit	11 bit	12 bit	13 bit	14 bit	15 bit	16 bit	17 bit	18 bit	19 bit	20 bit	21 bit	22 bit	23 bit	24 bit	25 bit	26 bit	27 bit	28 bit	29 bit	30 bit	31 bit	32 bit	33 bit				
1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0		
2	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0

# Uus klassi kasutajate süsteem

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<http://elrond.tud.ttu.ee/>

## Kuidas saada kasutajakontot:

- Et saada klassi kasutajakontot pead ennast juba eelnevalt olema registreerinud meie LDAP baasis. Kasutajakonto loomine toimub üle ÕIS-i ([ois.va.ttu.ee](http://ois.va.ttu.ee) → TTÜ üldparooli loomine).
- Järgmiseks etapiks on klassi serverisse kasutajakonto loomine. Selleks pöördu webi lehele [auth.ttu.ee](http://auth.ttu.ee), logi sisse oma kasutajanime ning parooliga ning kliki lingile "loo klassi kasutaja konto". Kindluse mõttes küsitakse veel korra parooli, mis langeb kokku sisselogimise parooliga ning genereeritakse kasutaja loomise päring. Päringuid töödeldakse perioodiliselt kuid MITTE KOHE pärast päringu sisestamist. Päringu täitmise staatust saab kontrollida webi lehelt [auth.ttu.ee](http://auth.ttu.ee).

# Juhendid arvutite seadmiseks

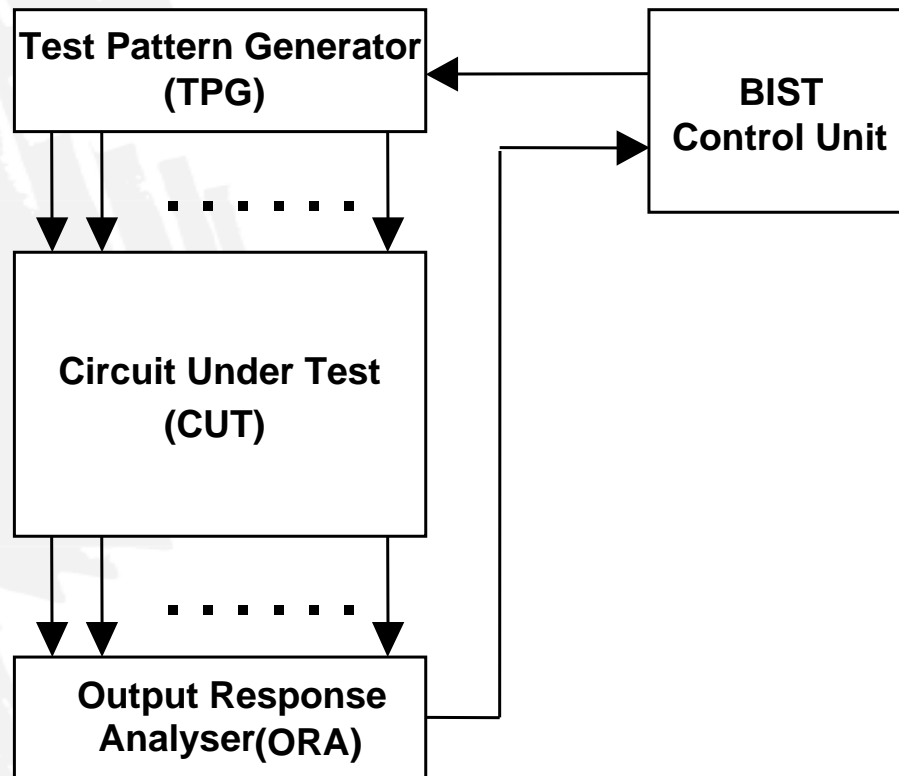
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Esmasel sisselogimisel järgnevad sammud:

1. vahetada oma shell ümber, selleks anda käsklus **konsoolis**  
**passwd -r ldap -e**
2. küsitakse parooli ja uue shelli väärtust, uueks shelliks  
panna: **/bin/tcsh**
3. **.cshrc** puudumisel kopeerida endale õige, järgneva käsuga  
**cp /home/kasutaja/.cshrc .**
4. Võta maha kommentaarid(e. #) **.cshrc** failis ridadel:  
**setenv TESTER**  
**setenv JDK16**
5. logida end arvutist korraks täielikult välja

# BIST (Built In Self Test)

ehk *sissehitatud isetestimine* on digitaalskeemi (mikroskeemi, plaadi, süsteemi jms) omadus iseennast testida.



# Why BIST?

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- **Motivations for BIST:**
  - Need for a cost-efficient testing (general motivation)
  - Doubts about the stuck-at fault model
  - Increasing difficulties with TPG (Test Pattern Generation)
  - Growing volume of test pattern data
  - Cost of ATE (Automatic Test Equipment)
  - Test application time
  - Gap between tester and UUT (Unit Under Test) speeds
- **Drawbacks of BIST:**
  - Additional pins and silicon area needed
  - Decreased reliability due to increased silicon area
  - Performance impact due to additional circuitry
  - Additional design time and cost



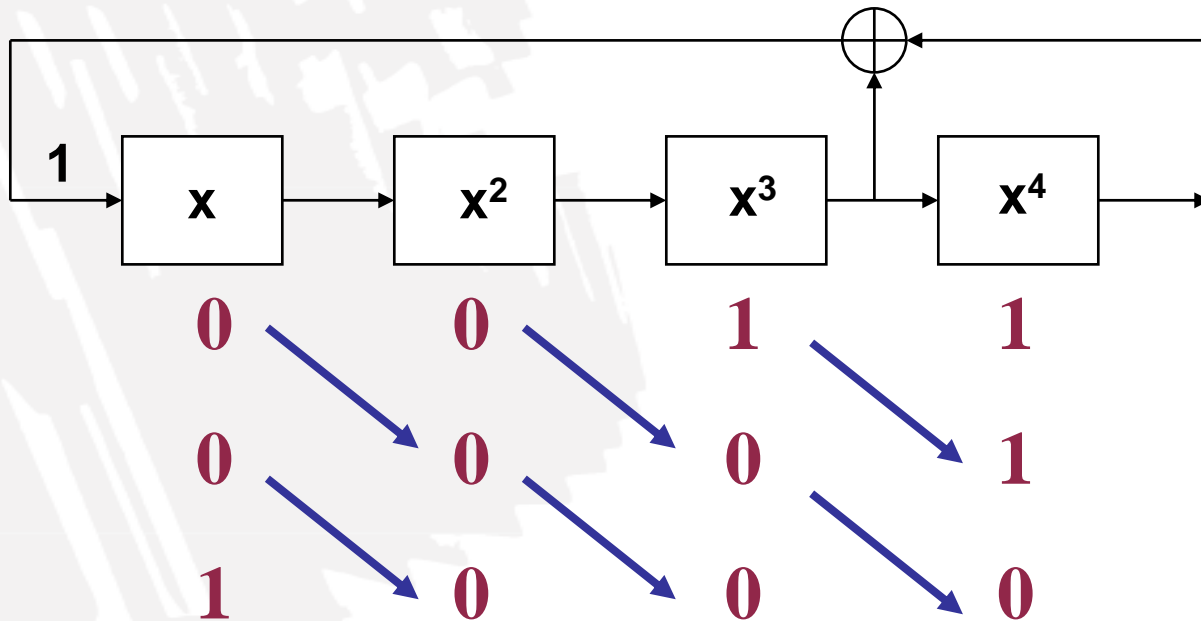
# Test Patterns Generator

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- **Store in ROM – too expensive**
- **Exhaustive**
- **Pseudo-exhaustive**
- **Pseudo-random (LFSR) – Preferred method**
- **Binary counters – use more hardware than LFSR**
- **Modified counters**
- **Test pattern augmentation**
  - **LFSR combined with a few patterns in ROM**
  - **Hardware diffracter – generates pattern cluster in neighborhood of pattern stored in ROM**

# LFSR

LFSR – Linear feedback shift register, hardware that generates **pseudo-random** pattern sequence



Characteristic Polynomial:  $P(x) = 1 + x^3 + x^4$

# Properties of Polynomials

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- *Irreducible polynomial* – cannot be factored, is divisible only by itself
- Irreducible polynomial of degree  $n$  is characterized by:
  - An odd number of terms including 1 term
  - Divisibility into  $1 + x^k$ , where  $k = 2^n - 1$
- Any polynomial with all even exponents can be factored and hence is *reducible*
- An irreducible polynomial is *primitive* if it divides the polynomial  $1+x^k$  for  $k = 2^n - 1$ , but not for any smaller positive integer  $k$
- Only *primitive polynomials* of an  $n$ -bit LFSR can generate maximum possible *unique* patterns  $2^n - 1$

# Reciprocal Polynomial

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The reciprocal polynomial of  $P(X)$  is defined by:

$$P^*(x) = x^n \cdot P(1/x)$$

$$X^a \Rightarrow X^{n-a}$$

## Example:

The reciprocal of polynomial  $P(x) = 1 + x + x^3$  is

is 
$$P^*(x) = x^3 \cdot \left(1 + \frac{1}{x} + \frac{1}{x^3}\right) = x^3 + x^2 + 1$$



**The reciprocal of a primitive polynomial is also primitive**

# Primitive Polynomials

Number of primitive polynomials of degree  $N$

N	No
1	1
2	1
4	2
8	16
16	2048
32	67108864

Table of primitive polynomials up to degree 31

N	Primitive Polynomials
1,2,3,4,6,7,15,22	$1 + X + X^n$
5,11, 21, 29	$1 + X^2 + X^n$
10,17,20,25,28,31	$1 + X^3 + X^n$
9	$1 + X^4 + X^n$
23	$1 + X^5 + X^n$
18	$1 + X^7 + X^n$
8	$1 + X^2 + X^3 + X^4 + X^n$
12	$1 + X + X^3 + X^4 + X^n$
13	$1 + X + X^4 + X^6 + X^n$
14, 16	$1 + X + X^3 + X^4 + X^n$