

# Optoelectronică

Curs 1

2022/2023

- ▶ La facultate, profesorul intreaba:
    - Intrebare de "nota 10": cum ma numesc?  
Toti tac.
    - Intrebare de "nota 8": la ce obiect aveti examen?  
Toti tac.
    - Intrebare de "nota 5": ce culoare are manualul (site-ul laboratorului)?
- Din ultimele randuri se aude o voce:
- Vrea sa ne pice magaru'!

# Disciplina 2022/2023

- ▶ 2C/1L Optoelectronică **OPTO**
- ▶ **Minim 7 prezente curs + laborator**
- ▶ Curs – conf. **Radu Damian**
  - an IV  $\mu$ E
  - Joi 08(:**10**)-10:00, C1
  - E – 70% din nota (50%+20%)
    - **20% test (VP) la curs**, saptamana 4-6?
  - probleme + (2p prez. curs)
  - toate materialele permise
- ▶ Laborator – **sl. Daniel Matasaru**
  - an IV  $\mu$ E
    - Luni 18-20, Miercuri 11-15 par
    - Max. 7 prezente
  - L – 30% din nota (+Caiet de laborator)

# Orar 2022/2023

## ▶ Curs

◦ Joi 08(:10)–10:00, C1

◦ ~~2C~~ ⇒ ~~3C~~

•  ~~$14 * 2/3 \approx 9.33$~~

•  ~~$9 : 10 C \approx 9C + E$~~

# Cuprins

- ▶ **Lumina ca undă electromagnetică\*** (ecuațiile lui Maxwell, ecuația undelor, parametri de propagare)
- ▶ **Elemente de fotometrie și radiometrie\*** (mărimi energetice/luminoase)
- ▶ **Fibra optică** (realizare, principiu de funcționare, atenuare, dispersie, banda de frecvență)
- ▶ **Cabluri optice** (tehnologie, conectori, lipire – splice)
- ▶ **Proiectare sistemică a legăturii pe fibra optică** (bandă de frecvență, balanța puterilor)
- ▶ **Emițătoare optice** (LED și dioda laser – realizare fizică și funcționare)
- ▶ **Receptoare optice** (dioda PIN, dioda cu avalanșă – realizare fizică și funcționare)
- ▶ **Amplificatoare transimpedanță** (parametri, scheme tipice, TIA în buclă deschisă, cu reacție, diferențiale, control automat al câștigului)
- ▶ **Realizarea circuitelor pentru controlul emițătoarelor optice** (parametri, scheme tipice, controlul puterii, multiplexoare)
- ▶ **Dispozitive de captare a energiei solare** (principiu de funcționare, utilizare, proiectare)

\* – VP

# Bibliografie

- ▶ <http://rf-opto.etti.tuiasi.ro>
- ▶ Irinel Casian-Botez, "Structuri Optoelectronice", Ed. "CANOVA", Iasi 2001, ISBN 973-96099-2-9
- ▶ Behzad Razavi – Design of Integrated Circuits for Optical Communications, Mc Graw Hill
- ▶ John Powers – An Introduction to Fiber Optic Systems
- ▶ IBM – Understanding Optical Communications: on-line <http://www.redbooks.ibm.com>
- ▶ Radu Damian, I Casian, D Matăsară – „Comunicatii Optice” , Indrumar de laborator, 2005
- ▶ MIT Course – Fundamentals of Photovoltaics, <https://ocw.mit.edu>

# Documentatie






# Documentatie

Laboratorul de Microunde si Opto x Orar ETTI x

Not secure | rf-opto.etti.tuiasi.ro/optoelectronics.php



English | Romana

Main **Courses** Master Staff Research Students Admin

Microwave CD Optical Communications **Optoelectronics** Internet Antennas Technology/Noise Practica Educational software

## Optoelectronics

**Course: OPTO (2019-2020)**

**Course Coordinator:** Assoc.P. Dr. Radu-Florin Damian  
**Code:** DID405M  
**Discipline Type:** DID; Required, Domain  
**Credits:** 4  
**Enrollment Year:** 4, Sem. 8

### Activities

**Course:** Instructor: Assoc.P. Dr. Radu-Florin Damian, 2 Hours/Week, Specialization Section, Timetable:  
**Laboratory:** Instructor: Assist.P. Dr. Petre-Daniel Matasaru, 1 Hours/Week, Group, Timetable:

### Evaluation

Type: **Colloquium**

**A:** 50%, (Test/Colloquium)  
**B:** 30%, (Seminary/Laboratory/Project Activity)  
**C:** 20%, (Tests during semester)

### Previous years

2018-2019	2017-2018	2016-2017	2015-2016	2014-2015	More years...
-----------	-----------	-----------	-----------	-----------	---------------

Server-ul "rf-opto" pastreaza istoricul materialelor pentru anii anteriori  
Alegeti anul recent corespunzator pentru vizualizare sau "More years" pentru a afisa mai multi ani din istoric.



# Documentatie

- ▶ RF-OPTO

- <http://rf-opto.etti.tuiasi.ro>

- ▶ Fotografie

- de trimis prin email: [rdamian@etti.tuiasi.ro](mailto:rdamian@etti.tuiasi.ro)

- necesara la laborator/curs

# Istoric

## Optoelectronics

### Course: OPTO (2019-2020)

**Course Coordinator:** Assoc.P. Dr. Radu-Florin Damian

**Code:** DID405M

**Discipline Type:** DID; Required, Domain

**Credits:** 4

**Enrollment Year:** 4, Sem. 8

### Activities

**Course:** Instructor: Assoc.P. Dr. Radu-Florin Damian, 2 Hours/Week, Specialization Section, Timetable:

**Laboratory:** Instructor: Assist.P. Dr. Petre-Daniel Matasaru, 1 Hours/Week, Group, Timetable:

### Evaluation

Type: Colloquium

**A:** 50%, (Test/Colloquium)

**B:** 30%, (Seminary/Laboratory/Project Activity)

**C:** 20%, (Tests during semester)

### Previous years

2018-2019

2017-2018

2016-2017

2015-2016

2014-2015

More years...

Server-ul "rf-opto" pastreaza istoricul materialelor pentru anii anteriori

Alegeti anul recent corespunzator pentru vizualizare sau "More years" pentru a afisa mai multi ani din istoric

# Istoric 2004–2021

## Previous years

2018-2019

2017-2018

2016-2017

2015-2016

2014-2015

More years...

## Optoelectronics

### Course: OPTO (2018-2019)

**Course Coordinator:** Assoc.P. Dr. Radu-Florin Damian

**Code:** DIS405M

**Discipline Type:** DID; Required, Domain

**Credits:** 3

**Enrollment Year:** 4, Sem. 8

### Activities

**Course:** Instructor: Assoc.P. Dr. Radu-Florin Damian, 2 Hours/Week, Specialization Section

**Laboratory:** Instructor: Assist.P. Dr. Petre-Daniel Matasaru, 1 Hours/Week, Group, Timetable:

### Evaluation

Type: **Colloquium**

**A:** 50%, (Test/Colloquium)

**B:** 30%, (Seminary/Laboratory/Project Activity)

**C:** 20%, (Tests during semester)

### Grades

[Aggregate Results](#)

### Attendance

## Previous years

2018-2019

2017-2018

2016-2017

2015-2016

2014-2015

2013-2014

2012-2011

## Optoelectronics, Structures, Technologies, Circuits

### Course: OSTC (2013-2014)

**Course Coordinator:** Assoc.P. Dr. Radu-Florin Damian

**Code:** DIS405M

**Discipline Type:** DIS; Required, Specialty

**Credits:** 4

**Enrollment Year:** 4, Sem. 7

### Activities

**Course:** Instructor: Assoc.P. Dr. Radu-Florin Damian, 2 Hours/Week, Specialization Section, Timetable:

**Laboratory:** Instructor: Assist.P. Dr. Petre-Daniel Matasaru, 1 Hours/Week, Half Group, Timetable:

### Evaluation

Type: **Colloquium**

**A:** 66%, (Test/Colloquium)

**B:** 17%, (Seminary/Laboratory/Project Activity)

**D:** 17%, (Homework/Specialty papers)

### Grades

[Aggregate Results](#)

### Materials

# Fotografii



## Date:

<b>Grupa</b>	5304 (2015/2016)
<b>Specializarea</b>	Tehnologii si sisteme de telecomunicatii
<b>Marca</b>	5184

[Trimite email acestui student](#) | [Adauga acest student la lista \(0\)](#)

## Detalii curente

<b>Finantare</b>	Buget
<b>Bursa</b>	Fara Bursa

## Observatii



## Date:

<b>Grupa</b>	5304 (2015/2016)
<b>Specializarea</b>	Tehnologii si sisteme de telecomunicatii
<b>Marca</b>	5184

[Acceseaza ca acest student](#)

## Note obtinute

Disciplina	Tip	Data	Descriere	Nota	Pondere	Obs.
TW			Tehnologii Web			
	N	17/01/2014	Nota Finala	10	-	
	A	17/01/2014	Colocenta Tehnologii Web 2013/2014	10	7.55	
	B	17/01/2014	Laborator Tehnologii Web 2013/2014	9	-	
	D	17/01/2014	Tema Tehnologii Web 2013/2014	9		



## Date:

<b>Grupa</b>	5304 (2015/2016)
<b>Specializarea</b>	Tehnologii si sisteme de telecomunicatii
<b>Marca</b>	5244

[Trimite email acestui student](#) | [Adauga acest student la lista \(0\)](#)

## Detalii curente

<b>Finantare</b>	Buget
<b>Bursa</b>	Bursa de Studii

## Observatii

# Fotografii

Start Didactic Master Colectiv Cercetare **Studenti** Admin

Note Lista Studenti Fotografii Statistici

Grupa 5403

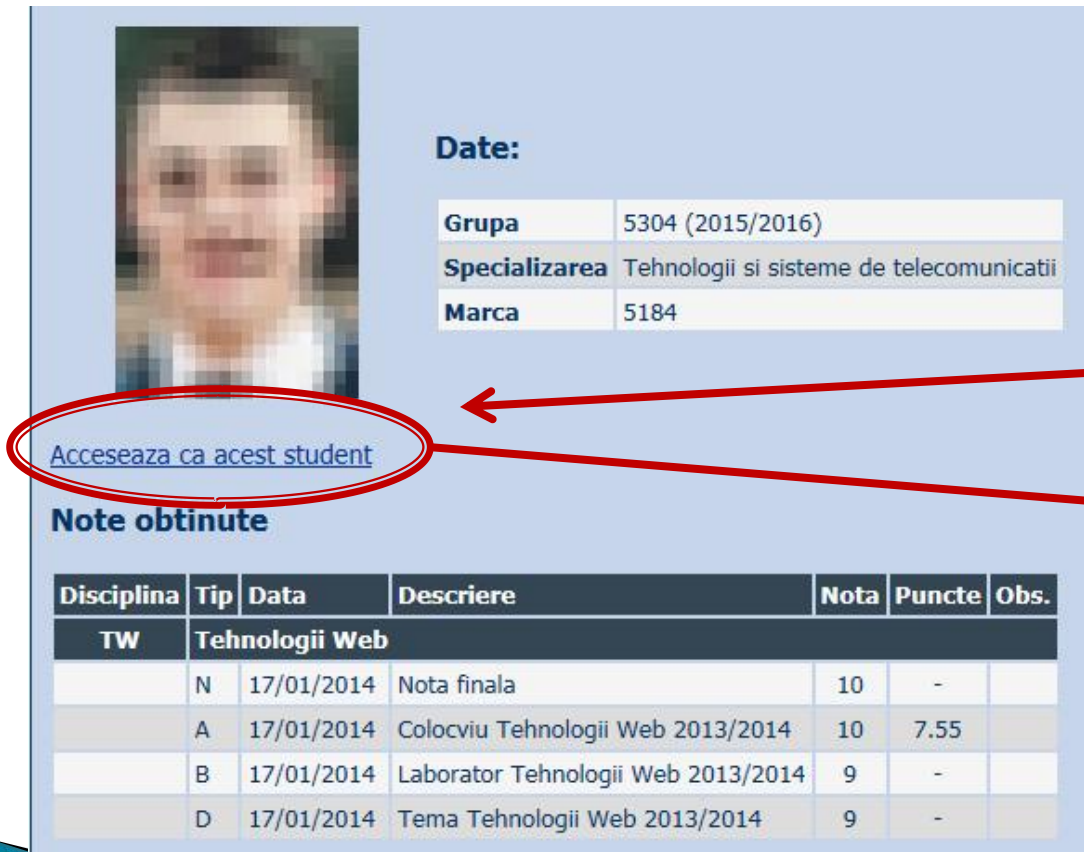
Nr. Student	Prezent	Nr. Student	Prezent	Nr. Student	Prezent
1 ANGHIELUS IONUT-MARIUS	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:	2 ANTIGHIN FLORIN-RAZVAN	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:	3 ANTONICA BIANCA	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:
4 APOSTOL PAVEL-MANUEL	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:	5 BALASCA IULIAN-PETRU	<input checked="" type="checkbox"/> Puncte: 0 Nota: 0 Obs:	6 BOSTAN ANDREI-PETRICIA	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:
7 BOTEZAT EMANUEL	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:	8 BUTUNOI GEORGE-MADALIN	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:	9 CHILEA SALUCA-MARIA	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:
10 CHERITOIU ECATERINA	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:	11 COJOC MARIUS	<input checked="" type="checkbox"/> Puncte: 0 Nota: 0 Obs:	12 COJOCARI AURA-FLORINA	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:

Nr. Student	Prezent
2 <u>ANTIGHIN FLORIN-RAZVAN</u>	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:



# Acces

## ▶ Personalizat



Student profile card showing a blurred photo, a 'Date:' section with a table of personal information, a link 'Acceseaza ca acest student', and a 'Note obtinute' table.

**Date:**

Grupa	5304 (2015/2016)
Specializarea	Tehnologii si sisteme de telecomunicatii
Marca	5184

[Acceseaza ca acest student](#)

**Note obtinute**

Disciplina	Tip	Data	Descriere	Nota	Puncte	Obs.
TW	Tehnologii Web					
N		17/01/2014	Nota finala	10	-	
A		17/01/2014	Colocviu Tehnologii Web 2013/2014	10	7.55	
B		17/01/2014	Laborator Tehnologii Web 2013/2014	9	-	
D		17/01/2014	Tema Tehnologii Web 2013/2014	9	-	



Login form with fields for Name, Email, and Verification Code, and a 'Trimite' button. A verification code '344bd9f' is displayed below the code field.

Nume

Email

Cod de verificare

344bd9f

Trimite



# Bonus

**Disciplina:** Optoelectronica, structuri, tehnologii, circuite  
**An:** 2015/2016

Bonus-uri care se aplica la nota de la teza obtinute prin:

- prezenta la curs (0.5p / 3pr)
- 3 miniteste aplicate la curs (max. 3 X 1.5p)
- contributie la site rf-opto (foto <C5=1p, >C5=0.5p)

Nr.	Student	Grupa	Prezente curs	Bonus prezenta	Bonus foto	Bonus T1	Bonus T2	Bonus T3	Total Bonus	Obs.
1	<a href="#">CIOLPAN OCTAVIAN</a>	5306	3	0.5					0.5	-
2	<a href="#">NITA COSTEL-CATALIN</a>	5307	4	0.5	1				1.5	-
3	<a href="#">BARON BOGDAN-IONUT</a>	5405	12	2	1	0.5		0.75	4.25	-

## Prezenta

[Curs](#)  
[Laborator](#)

## Liste

[Studenti care nu pot intra in examen](#)  
[Bonus-uri acumulate](#)

- ▶ **Minim** 7 prezente
- ▶ 0.5p/3(2)prez
- ▶ 3 teste
- ▶ foto <C3 / <C5

# Online

- ▶ acces la **examene** necesita **parola** primita prin **email**

English | Romana |

Start Didactic Master Colectiv Cercetare Stud

Note Lista Studenti Examene Fotografii

## POPESCU GOPO ION

**Fotografia nu exista**

**Date:**

Grupa	5700 (2019/2020)
Specializarea	Inginerie electronica si telecomunicatii
Marca	7000021

Acceseaza ca acest student | [cere acces la licente](#)

**Note obtinute**

Inca nu a fost notat.

Start Didactic Master Colectiv C

Note Lista Studenti Examene Fotografii

## Identificare

Introduceti numele si adresa de email utilizata la inscriere

Nume  
POPESCU GOPO

**E-mail/Parola**

Introduceti codul afisat mai jos

**4db4457**

Trimite

# Online

- ▶ acces email/parola

Start Didactic Master Colectiv

Note Lista Studenti Examene Fotografii

## POPESCU GOPO ION

Fotografia nu exista

Date:

Grupa	5700 (2019/2020)
Specializarea	Inginerie electronica
Marca	7000021

Se acceseaza site-ul [ca acest student!](#)

Start Didactic Master Colectiv

Note Lista Studenti Examene Fotografii

## POPESCU GOPO ION

Fotografia nu exista

Date:

Grupa	5700 (2019/2020)
Specializarea	Inginerie electronica s
Marca	7000021

Se acceseaza site-ul [ca acest student \(inclusiv examene\)!](#)

# Parola

## ▶ primita prin email

Important message from RF-OPTO

Inbox x



Radu-Florin Damian

to me, POPESCU

Romanian > English Translate message



Laboratorul de Microunde si Optoelectronica  
Facultatea de Electronica, Telecomunicatii si Tehnologia Informatiei  
Universitatea Tehnica "Gh. Asachi" Iasi

**In atentie: POPESCU GOPO ION**

Parola pentru a accesa examenele pe server-ul **rf-opto** este

Parola: [REDACTED]

Identificati-va pe [server](#), cu parola, cat mai rapid, pentru confirmare.

**Memorati** acest mesaj intr-un loc sigur, pentru utilizare ulterioara

**Attention: POPESCU GOPO ION**

The password to access the exams on the **rf-opto** server is

Password: [REDACTED]

Login to the [server](#), with this password, as soon as possible, for confirmation.

**Save** this message in a safe place for later use

Reply

Reply all

Forward

Subject

Correspondents

Important message from RF-OPTO → POPESCU GOPO ION

Validation of MIDCR exam from 02/05/2020

From: Me <rdamian@etti.tuiasi.ro>

Subject: Important message from RF-OPTO

To: [REDACTED]

Cc: Me <rdamian@etti.tuiasi.ro>

Laboratorul de Microunde si Optoelectronica  
Facultatea de Electronica, Telecomunicatii si Tehnologia Informatiei  
Universitatea Tehnica "Gh. Asachi" Iasi

**In atentie: POPESCU GOPO ION**

Parola pentru a accesa examenele pe server-ul **rf-opto** este

Parola: [REDACTED]

Identificati-va pe [server](#), cu parola, cat mai rapid, pentru confirmare.

**Memorati** acest mesaj intr-un loc sigur, pentru utilizare ulterioara

**Attention: POPESCU GOPO ION**

The password to access the exams on the **rf-opto** server is

Password: [REDACTED]

Login to the [server](#), with this password, as soon as possible, for confirmation.

**Save** this message in a safe place for later use

# Adrese email

## ▶ Sefii de grupa!

- lista cu adrese de email **utilizate** de toti studentii care doresc acces la toate informatiile de pe site
  - poate fi @student.etti.tuiasi.ro (@gmail @yahoo etc.)
- -> **rdamian@etti.tuiasi.ro**



# Manual examen online

- ▶ Aplicatia de examen online utilizata intens la:
  - ~~curs (prezenta)~~
  - ~~miniteste~~
  - ~~examen~~

## Materials

### Other data

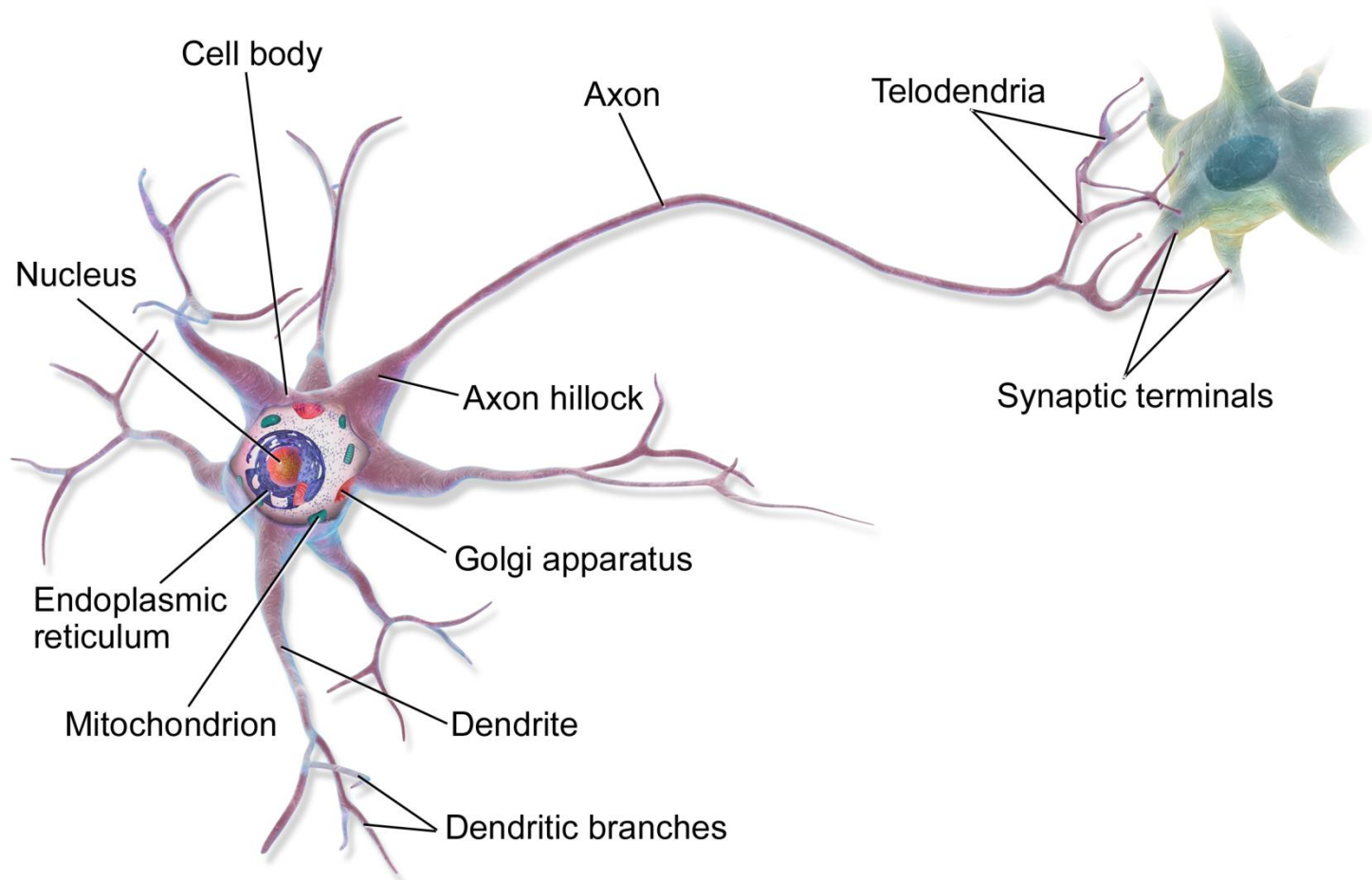
[Manual examen on-line](#) (pdf, 2.65 MB, ro, 🇷🇴)

[Simulare Examen](#) (video) (mp4, 65.12 MB, ro, 🇷🇴)

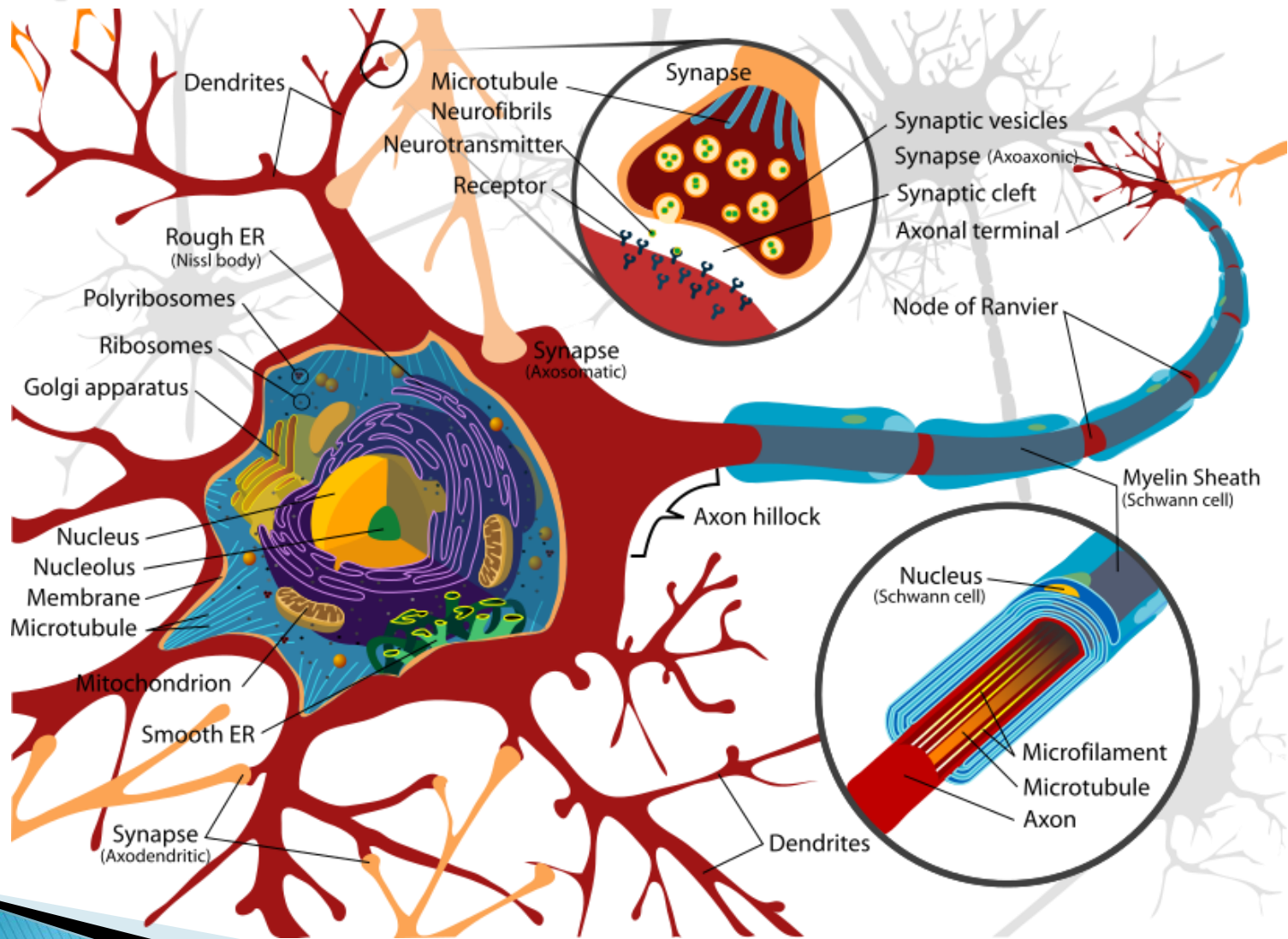
## Microwave Devices and Circuits (Englis



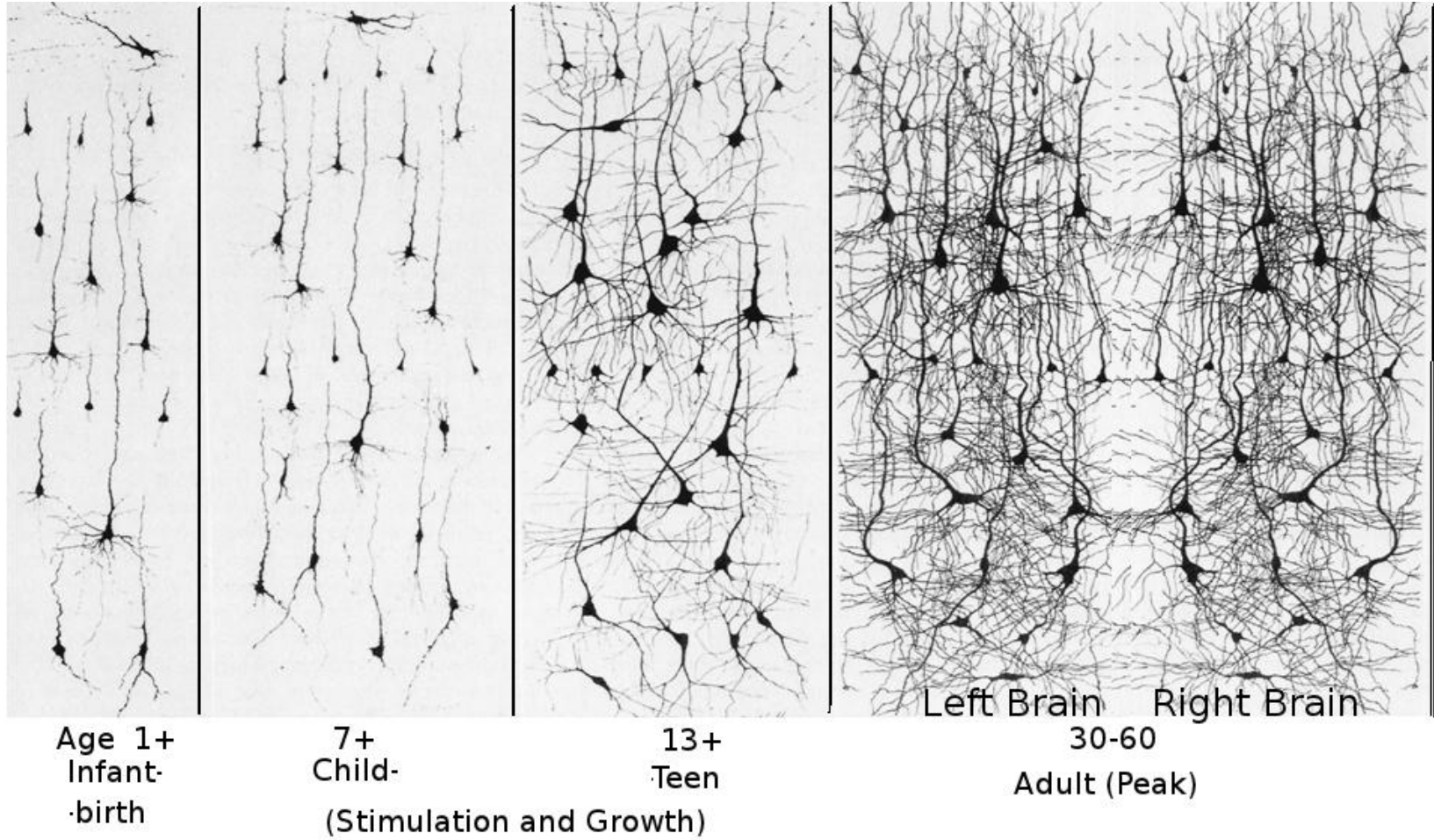
# Scop 1



# Scop 2



# Scop 3





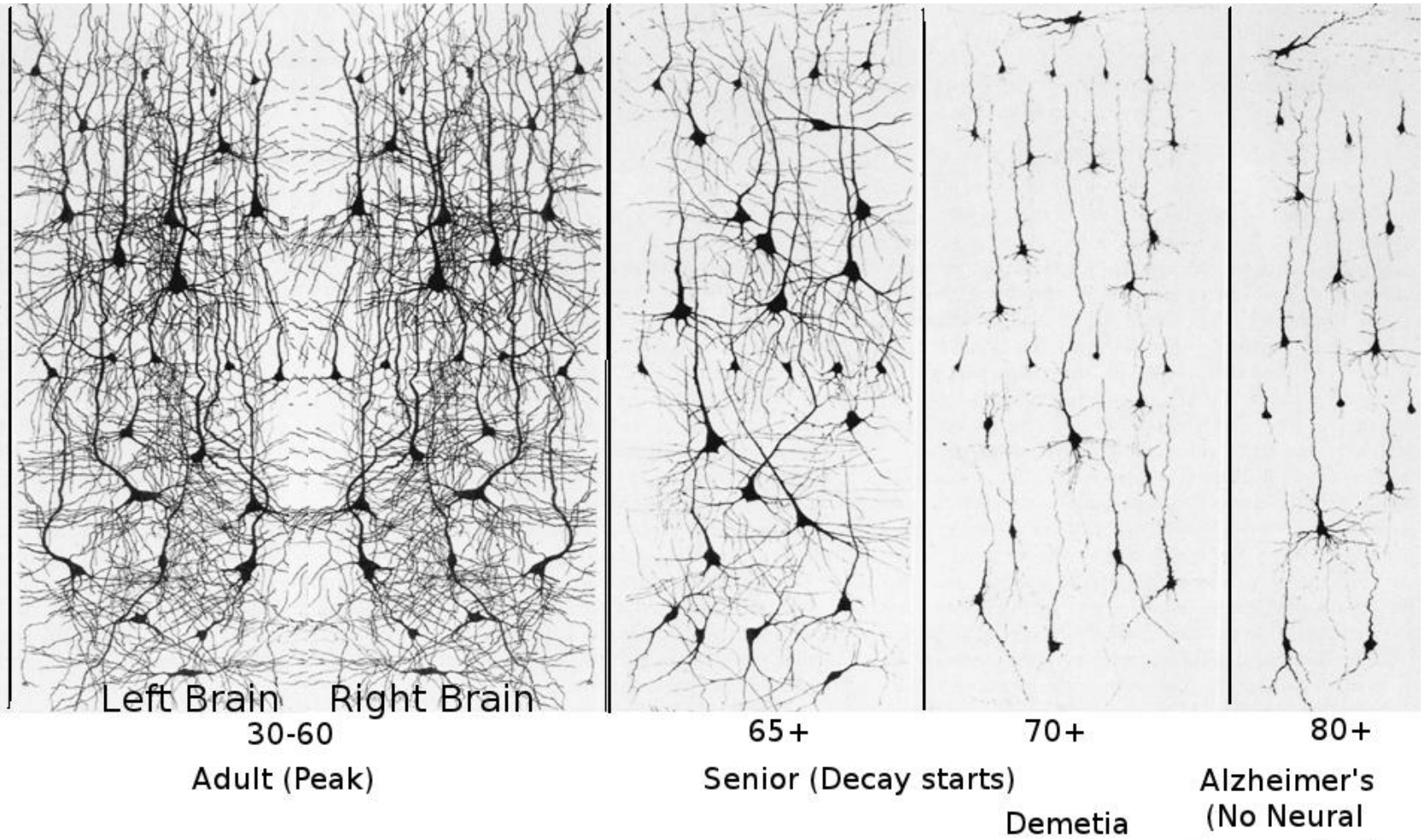
# Scop 4



**Sinapse  
“ingineresti”**



# Termen





~1930

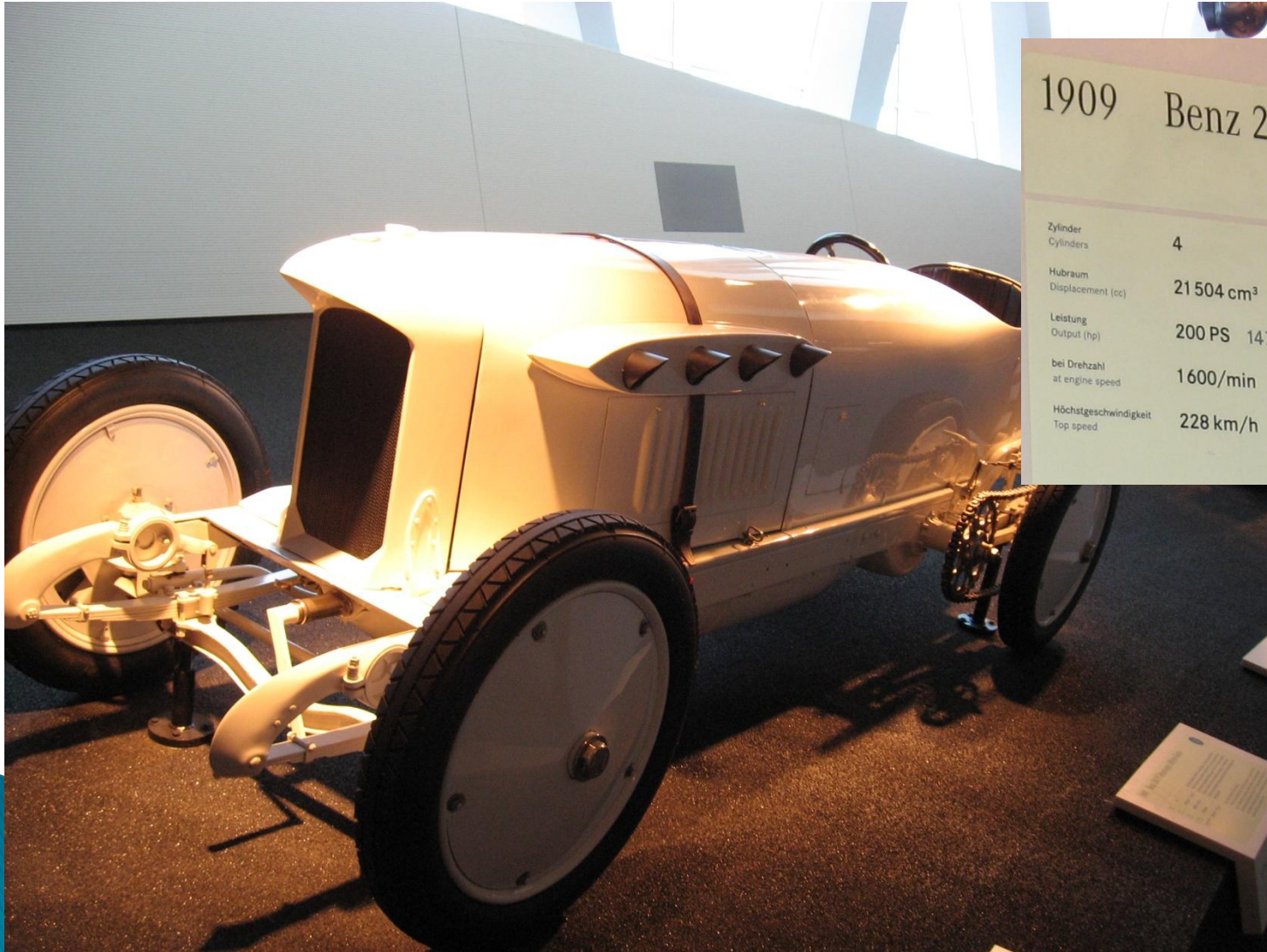




~1930



# 1909



## 1909 Benz 200 PS Rennwagen »Blitzen-Benz«

Zylinder Cylinders	4
Hubraum Displacement (cc)	21 504 cm <sup>3</sup> 1 312 cu in
Leistung Output (hp)	200 PS 147 kW
bei Drehzahl at engine speed	1 600/min
Höchstgeschwindigkeit Top speed	228 km/h 142 mph

Der »Blitzen-Benz« ist 1909 der erste 200 km/h fähige. Seine größten Erfolge erzielt er mit dem 4-Zylindermotor ausgestatteten Rekordwagen in der Hand des Burman mit 228 km/h über die Saale. Er ist damit das schnellste Fahrzeug aller Zeiten auf jeder Eisenbahn.

Benz »Lightning Benz« 200 hp racing car  
In 1909 the Lightning Benz



# 1930-1950



# Tehnologie

> 2010

< 1950

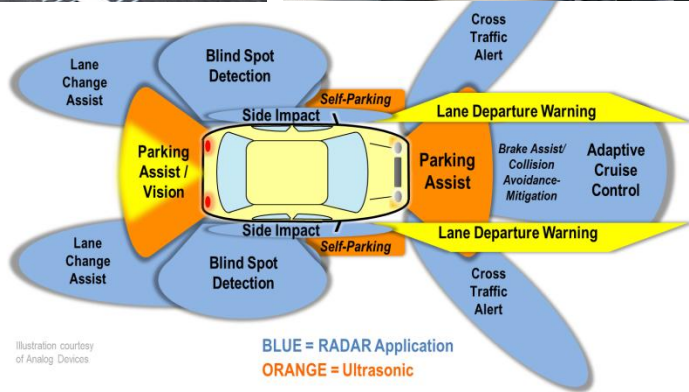


Illustration courtesy of Analog Devices

# Tehnologie

<b>1x1 = 1</b>	<b>2x1 = 2</b>	<b>3x1 = 3</b>	<b>4x1 = 4</b>	<b>5x1 = 5</b>
<b>1x2 = 2</b>	<b>2x2 = 4</b>	<b>3x2 = 6</b>	<b>4x2 = 8</b>	<b>5x2 = 10</b>
<b>1x3 = 3</b>	<b>2x3 = 6</b>	<b>3x3 = 9</b>	<b>4x3 = 12</b>	<b>5x3 = 15</b>
<b>1x4 = 4</b>	<b>2x4 = 8</b>	<b>3x4 = 12</b>	<b>4x4 = 16</b>	<b>5x4 = 20</b>
<b>1x5 = 5</b>	<b>2x5 = 10</b>	<b>3x5 = 15</b>	<b>4x5 = 20</b>	<b>5x5 = 25</b>
<b>1x6 = 6</b>	<b>2x6 = 12</b>	<b>3x6 = 18</b>	<b>4x6 = 24</b>	<b>5x6 = 30</b>
<b>1x7 = 7</b>	<b>2x7 = 14</b>	<b>3x7 = 21</b>	<b>4x7 = 28</b>	<b>5x7 = 35</b>
<b>1x8 = 8</b>	<b>2x8 = 16</b>	<b>3x8 = 24</b>	<b>4x8 = 32</b>	<b>5x8 = 40</b>
<b>1x9 = 9</b>	<b>2x9 = 18</b>	<b>3x9 = 27</b>	<b>4x9 = 36</b>	<b>5x9 = 45</b>
<b>1x10 = 10</b>	<b>2x10 = 20</b>	<b>3x10 = 30</b>	<b>4x10 = 40</b>	<b>5x10 = 50</b>
<b>6x1 = 6</b>	<b>7x1 = 7</b>	<b>8x1 = 8</b>	<b>9x1 = 9</b>	<b>10x1 = 10</b>
<b>6x2 = 12</b>	<b>7x2 = 14</b>	<b>8x2 = 16</b>	<b>9x2 = 18</b>	<b>10x2 = 20</b>
<b>6x3 = 18</b>	<b>7x3 = 21</b>	<b>8x3 = 24</b>	<b>9x3 = 27</b>	<b>10x3 = 30</b>
<b>6x4 = 24</b>	<b>7x4 = 28</b>	<b>8x4 = 32</b>	<b>9x4 = 36</b>	<b>10x4 = 40</b>
<b>6x5 = 30</b>	<b>7x5 = 35</b>	<b>8x5 = 40</b>	<b>9x5 = 45</b>	<b>10x5 = 50</b>
<b>6x6 = 36</b>	<b>7x6 = 42</b>	<b>8x6 = 48</b>	<b>9x6 = 54</b>	<b>10x6 = 60</b>
<b>6x7 = 42</b>	<b>7x7 = 49</b>	<b>8x7 = 56</b>	<b>9x7 = 63</b>	<b>10x7 = 70</b>
<b>6x8 = 48</b>	<b>7x8 = 56</b>	<b>8x8 = 64</b>	<b>9x8 = 72</b>	<b>10x8 = 80</b>
<b>6x9 = 54</b>	<b>7x9 = 63</b>	<b>8x9 = 72</b>	<b>9x9 = 81</b>	<b>10x9 = 90</b>
<b>6x10 = 60</b>	<b>7x10 = 70</b>	<b>8x10 = 80</b>	<b>9x10 = 90</b>	<b>10x10 = 100</b>

$$2 \times 1 = 2$$

$$2 \times 2 = 4$$

$$2 \times 3 = 6$$

$$2 \times 4 = 8$$

$$2 \times 5 = 10$$

$$2 \times 6 = 12$$

$$2 \times 7 = 14$$

$$2 \times 8 = 16$$

$$2 \times 9 = 18$$

$$2 \times 10 = 20$$



# Examen online

- ▶ intotdeauna **contratimp**
  - perioada lunga (prezenta curs/rezultate laborator)
  - perioada scurta (teste: 15min, examen: 2h)

Start Didactic Master Colectiv Cercetare **Studenti**

Note Lista Studenti **Examene** Fotografii

**Anunț**  
17:28 (29/04/2020)

**Material suport**  
17:30 (29/04/2020)

**Subiecte**  
17:32 (29/04/2020)

**Rezultate**  
17:35 (29/04/2020)

**Finalizare**  
17:45 (29/04/2020)

**Confirmare**  
17:45 (30/04/2020)

Urmatorul interval de timp in:  
**01 m 08 s**  
[Reincarca acum](#)

## Anunț

In acest examen se verifica diverse actiuni ale studentilor pentru examen

## Ora pe server

Toate examenele sunt bazate pe fusul orar al server-ului (ar putea sa fie diferit de timpul local). Pentru referinta ora pe server este acum:

**29/04/2020 17:28:51**



# Examen

- ▶ subiecte individuale
- ▶ Note
  - 2007:  $9.67 \pm 0.66 / 8.81 \pm 1.22$
  - 2008:  $6.24 \pm 1.36 / 4.82 \pm 2.10$
  - 2009:  $5.10 \pm 1.46$
  - 2010:  $3.89 \pm 1.32$
- ▶ La prima aplicare (neanuntata)
  - 50% din studenti au parasit examenul in primele 10 minute
  - 50% din cei ramasi nu au promovat
  - promovabilitate totala **25%**, rata contestatiilor: **0%**
- ▶ Urmatoarele examinari (anuntate)
  - rata contestatiilor: 0%

# Examen

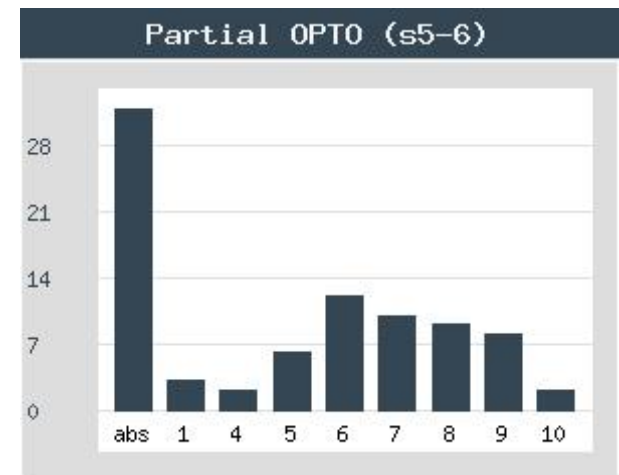
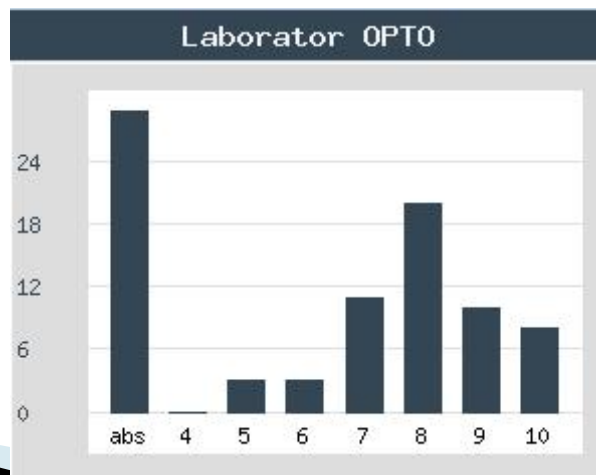
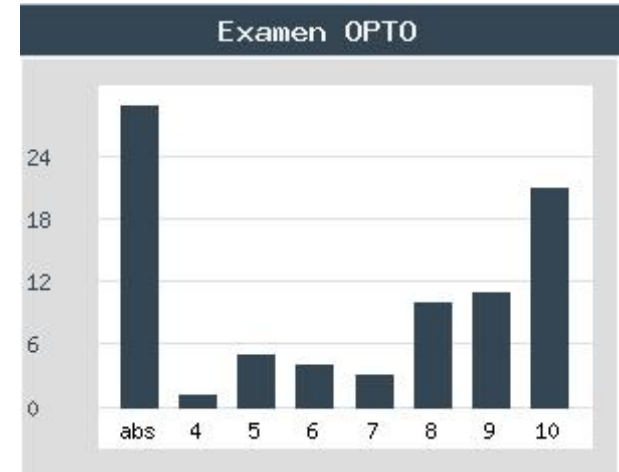
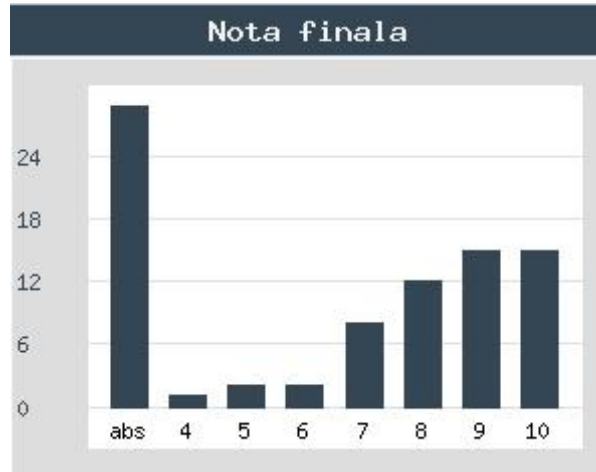


# Examen

- ▶ subiecte **individuale**

# Note

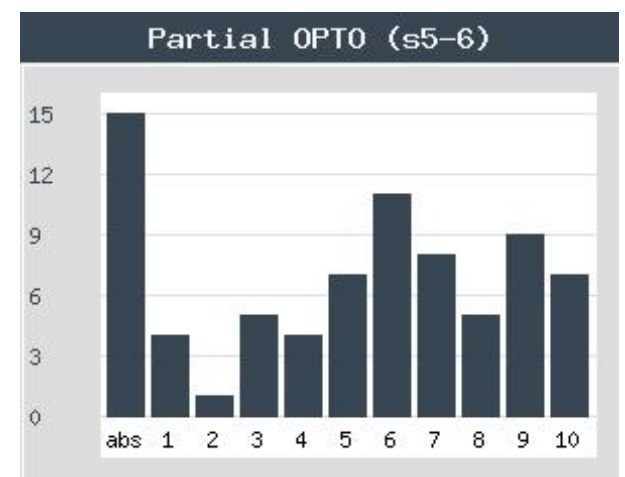
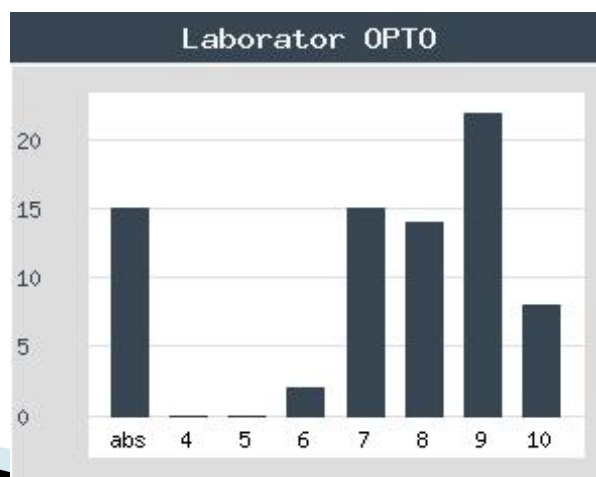
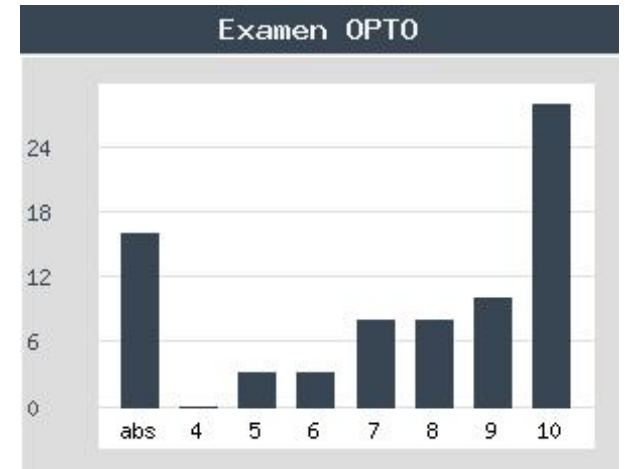
## ▶ 2018/2019 – clasic





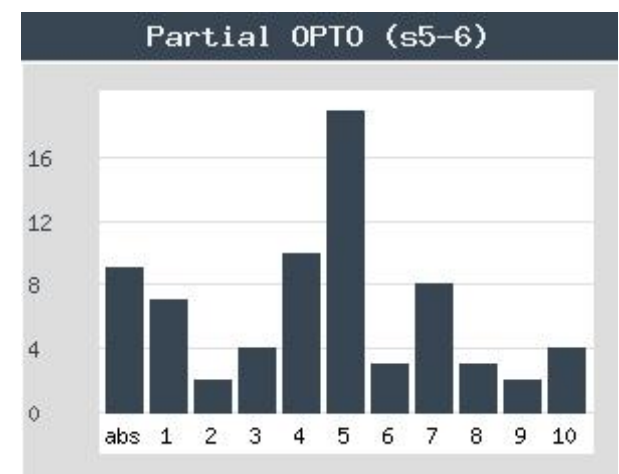
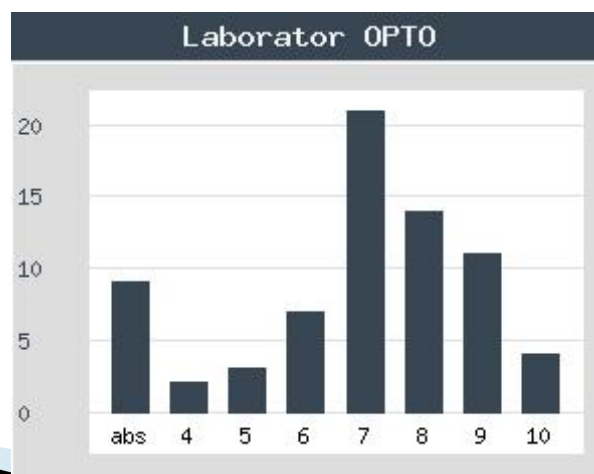
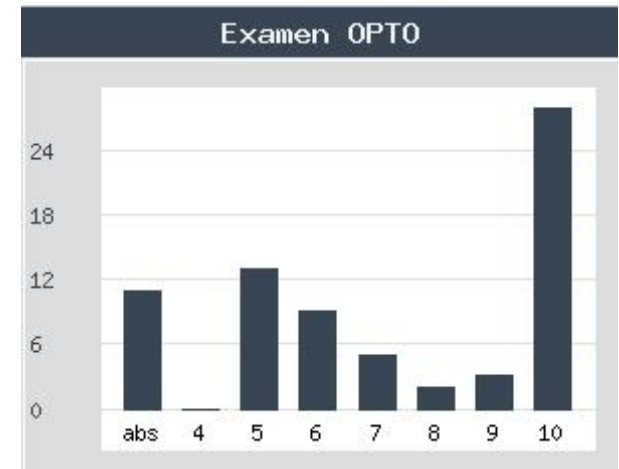
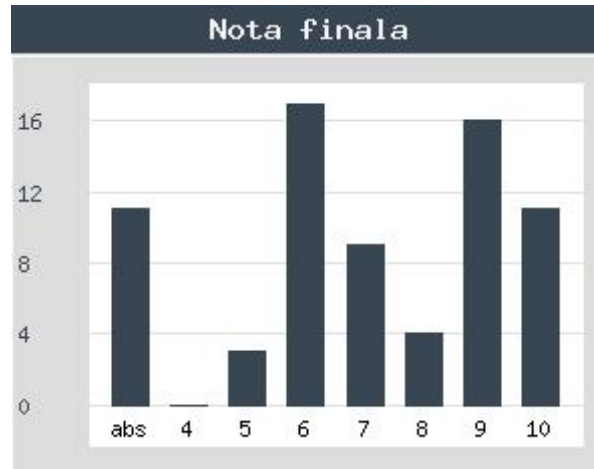
# Note

## ▶ 2019/2020 – online



# Note

## ▶ 2020/2021 – online



# Reprezentare logaritmică

$$\text{dB} = 10 \cdot \log_{10} (P_2 / P_1)$$

$$\text{dBm} = 10 \cdot \log_{10} (P / 1 \text{ mW})$$

$$0 \text{ dB} = 1$$

$$+ 0.1 \text{ dB} = 1.023 (+2.3\%)$$

$$+ 3 \text{ dB} = 2$$

$$+ 5 \text{ dB} = 3$$

$$+ 10 \text{ dB} = 10$$

$$-3 \text{ dB} = 0.5$$

$$-10 \text{ dB} = 0.1$$

$$-20 \text{ dB} = 0.01$$

$$-30 \text{ dB} = 0.001$$

$$0 \text{ dBm} = 1 \text{ mW}$$

$$3 \text{ dBm} = 2 \text{ mW}$$

$$5 \text{ dBm} = 3 \text{ mW}$$

$$10 \text{ dBm} = 10 \text{ mW}$$

$$20 \text{ dBm} = 100 \text{ mW}$$

$$-3 \text{ dBm} = 0.5 \text{ mW}$$

$$-10 \text{ dBm} = 100 \mu\text{W}$$

$$-30 \text{ dBm} = 1 \mu\text{W}$$

$$-60 \text{ dBm} = 1 \text{ nW}$$

$$[\text{dBm}] + [\text{dB}] = [\text{dBm}]$$

$$[\text{dBm/Hz}] + [\text{dB}] = [\text{dBm/Hz}]$$

$$[\text{x}] + [\text{dB}] = [\text{x}]$$

# Calculul atenuarii/amplificarii

$$\text{Atenuare/Amplificare} = \frac{P_{out}}{P_{in}}$$

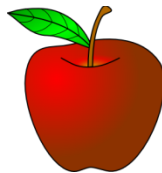
$$\text{Atenuare [dB]} = [-] 10 \cdot \log_{10} \left( \frac{P_{out}}{P_{in}} \right)$$

$$\text{Atenuare [dB]} = [-] 10 \cdot \log_{10} \left( \frac{P_{out}}{P_0} \cdot \frac{P_0}{P_{in}} \right) = [-] 10 \cdot \left[ \log_{10} \left( \frac{P_{out}}{P_0} \right) - \log_{10} \left( \frac{P_{in}}{P_0} \right) \right]$$

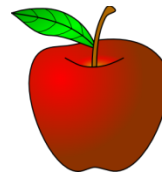
$$\text{Pierderi [dB]} = [-] (P_{out} [\text{dBm}] - P_{in} [\text{dBm}])$$



=



-





# Contact

- ▶ Laboratorul de microunde si optoelectronica
- ▶ <http://rf-opto.etti.tuiasi.ro>
- ▶ [rdamian@etti.tuiasi.ro](mailto:rdamian@etti.tuiasi.ro)