ACADEMIC AFFAIRS OFFICE
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

No. Acd./ 8093 /UG-15 Dated: July 26 , 2019

NOTIFICATION

Subject: Restructuring in the programme structure of M.Tech. (Microelectronics and VLSI) and to introduce a new PCC course (Item No. 79.5)

The Senate in its 79th meeting held on 19.07.2019 considered and approved the proposal of Department of Electronics & Communication Engg. to restructure the programme structure of M.Tech. (Microelectronics and VLSI) and to introduce a new PCC course ECN-579 "Foundations of Semiconductor Device Physics".

The approved structure and syllabus of a new PCC course ECN-579 are enclosed herewith as **Appendix- A**.

Asstt. Registrar (Curriculum)

Encl: as above

Copy to(through e-mail):-

1. Chairman Senate & Director
2. Head, Department of Electronics & Communication Engg.
3. All faculty
4. All Head of Departments/Centres
5. Dean of Academic Affairs
6. Associate Deans of Academic Affairs (Admission/Curriculum/Evaluation)
7. Asstt. Registrar (Meetings)
8. Joint Registrar (Academics)
9. Channel I/ Academic webpage of iitr.ac.in

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Program Code: **31** **M.Tech. (Microelectronics & VLSI)**
Department: **EC** **Electronics & Communication Engineering**
Year: **I**

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weight (%)				
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Semester- I (Autumn)														
1.	ECN-573	Digital VLSI Circuit Design	PCC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
2.	ECN-575	Microelectronics Lab-1	PCC	2	0	0	3	0	3	-	100	-	-	-
3.	ECN-576	Simulation Lab-1	PCC	2	0	0	3	0	3	-	100	-	-	-
4.	ECN-578	Digital System Design	PCC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
5.	ECN-579	Foundations of Semiconductor device physics	PCC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
6.		ELECTIVE-I	PEC	4	-	-	-	-	-	-	-	-	-	-
		Total		20	9	3	6	9	6					
Semester-II (Spring)														
1.	ECN-577	VLSI Technology	PCC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
2.	ECN-700	Seminar	SEM	2	0	0	0	0	3	-	100	-	-	-
3.		ELECTIVE-II	PEC	4	-	-	-	-	-	-	-	-	-	-
4.		ELECTIVE-III	PEC	4	-	-	-	-	-	-	-	-	-	-
5.		ELECTIVE-IV	PEC	4	-	-	-	-	-	-	-	-	-	-
6.		ELECTIVE-V	PEC	2	-	-	-	-	-	-	-	-	-	-
		Total		**20**	**3**	**1**	**0**	**3**	**3**					

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

Program Code: **31** **M.Tech. (Microelectronics & VLSI)**
Department: **EC** **Electronics & Communication Engineering**
Year: **II**

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weight (%)				
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
Semester- I (Autumn)														
1.	ECN-701A	Dissertation Stage–I (to be continued next semester)	DIS	12	-	-	-	-	-	-	-	-	100	-
		Total		12										
Note: Students can take 1 or 2 audit courses as advised by the supervisor, if required.														
Semester-II (Spring)														
1.	ECN-701B	Dissertation Stage–II (contd. From III	DIS	18	-	-	-	-	-	-	-	-	100	-
		Total		18										

Summary				
Semester	1	2	3	4
Semester-wise Total Credits	**20**	**20**	**12**	**18**
Total Credits	**70**			

Program Elective Courses (Microelectronics & VLSI)

Teaching Scheme					Contact Hours/Week			Exam Duration		Relative Weight (%)				
S. No.	Subject Code	Course Title	Subject Area	Credits	L	T	P	Theory	Practical	CWS	PRS	MTE	ETE	PRE
1	ECN-571	Semiconductor Device Modeling	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
2	ECN-572	MOS Device Physics	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
3	ECN-581	Analog VLSI Circuit Design	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
4	ECN-582	Semiconductor Microwave Devices & Applications	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
5	ECN-583	Optoelectronic Materials & Devices	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
6	ECN-584	Mixed Signal Circuit Design	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
7	ECN-585	VLSI System Design	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
8	ECN-586	Device & Circuit Interaction	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
9	ECN-587	Nano Scale Devices	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
10	ECN-588	Performance and Reliability of VLSI Circuits	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
11	ECN-589	Advanced VLSI Interconnects	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
12	ECN-590	Organic Electronics	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
13	ECN-591	VLSI Physical Design	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
14	ECN-592	Compound Semiconductors and RF Devices	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
15	ECN-593	CAD for VLSI	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
16	ECN-594	VLSI Digital Signal Processing	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
17	ECN-595	VLSI Testing and Testability	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-

18	ECN-596	MEMS and NEMS	PEC	4	3	1	0	3	0	20-35	-	20-30	40-50	-
19	ECN-597	Microelectronics Lab.-2	PEC	2	-	-	2	-	-	-	100	-	-	-
20	ECN-598	Simulation Lab.-2	PEC	2	-	-	2	-	-	-	100	-	-	-

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT. /CENTRE: **Electronics and Communication Engineering**

1. Subject Code**: ECN – 579** Course Title**: Foundations of Semiconductor Device Physics**

2. Contact Hours: **L: 3 T: 1 P: 0**

3. Examination Duration (Hrs.): **Theory: 3 Practical :0**

4. Relative Weight**: CWS:20-35 PRS:0 MTE:20-30 ETE:40-50 PRE:0**

5. Credits**: 04** 6. Semester : **Autumn**

7. Pre-requisite**: None**

8. Subject Area**: PCC**

9. Objective: To instigate fundamental concepts of solid state physics and basic semiconductor devices.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1.	**Basic Semiconductor properties**: Brief history of semiconductor revolution; types of semiconductor; crystal structure analysis – unit cell, Bravais Lattice, Miller Indices.	3
2.	**Review of quantum mechanics and energy-band theory**: Quantum concepts; basic formalism – particle in a 1-D box, finite potential well; Bloch Theorem; One dimensional analyses of semiconductors – K-P model, Brillouin zone; extrapolation of these concepts to three dimensions.	8
3.	**Equilibrium carrier statistics and R-G processes**: Density of states in 1D, 2D and 3D systems; Fermi-Dirac distribution, FD integral; Maxwell-Boltzmann approximation; equilibrium carrier concentration. Mass-action law; calculation of fermi level in intrinsic, extrinsic and freeze-out conditions; Degenerate semiconductors; recombination-generation (R-G) statistics; surface R-G processes;	7
4.	**Carrier transport:** carrier drift – mobility, narrow dimension effects, scattering phenomenon velocity saturation; diffusion current; Einstein relationship; Quasi-fermi levels, continuity equation; tunneling mechanisms. resistivity, Hall effect	7
5.	**Theory of P-N junction and metal-semiconductor junctions**: electrostatics – built in potential, depletion approximation, Poisson's equation; forward and reverse bias; ideal diode I-V characteristics; breakdown mechanisms; high injection effects; transient and A-C conditions; Metal-semiconductor junctions - Schottky, ohmic and rectifying contacts; semiconductor heterojunctions, Quantum well structures.	7

6.	**MOS capacitor**: Ideal Si/SiO2 MOS capacitor – solution of Poisson's equation, depletion approximation, HFCV, LFCV, deep depletion; non-ideal MOS capacitor - work-function difference, oxide and interface charges, polysilicon depletion effect, quantum effects, tunneling through the insulator.	10
	Total	**42**

11. Suggested Books:

Sl. No.	**Name of Books/ Authors**	**Year of Publication**
1.	Robert F. Pierret, "Advanced Semiconductor Fundamentals," Pearson Prentice Hall.	2002
2.	Robert F. Pierret, "Semiconductor Device Fundamentals," Pearson.	2006
3.	Ben G. Streetman and Sanjay K. Banerjee, "Solid State Electronic Devices," Pearson Education India Pvt. Ltd.	2015
4.	Donald A. Neamen, "Semiconductor Physics and Devices", McGraw Hill Higher Education	2002
5	S. M. Sze and Kwok K. Ng, "Physics of Semiconductor Devices," Wiley	2008
6	Mark Lundstrom, "Fundamentals of Carrier Transport," Cambridge University Press	2009
7	K. Seeger, "Semiconductor Physics," Springer	2004