	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2018-19**
Department	**Electronics and Communication Engineering**	Semester	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
EC 417	**High Band Gap Device Modelling**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes		
	High bandgap Semiconductor (Especially III-V) basics and comparison with silicon		CO1	Able to understand basics of high bandgap semiconductor model.
	High bandgap Semiconductor device basics		CO2	Able to learn basic of process modelling.
	Basics of III-V device (Especially HEMT & HBT)		CO3	Able to learn basic of electrical modelling.
	III-V device (Especially HEMT & HBT) models		CO4	Able to do various device level modelling like analytical, empirical and LUT.

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	**3**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**3**
2	CO2	**3**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**2**
3	CO3	**2**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**
4	CO4	**2**	**2**	**3**	**-**	**2**	**2**	**3**	**-**	**2**	**-**	**-**	**1**	**2**	**3**	**2**
5	CO5	**2**	**2**	**3**	**-**	**2**	**2**	**3**	**-**	**2**	**-**	**-**	**1**	**3**	**3**	**3**
6	CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SYLLABUS

No.	Content	Hours	COs
I	**High Bandgap Semiconductor Material modelling:** Introduction of density functional theory (DFT) tool and atomistic tool kit (ATK). Difference between Silicon and the high bandgap semiconductor, Impact and modelling of epitaxial crystal, Interfaces, Hetero junction interface and Homo junction interface, Bandgap engineering, defects, trap, dislocation.	**8**	**CO1**
II	**High Bandgap Semiconductor Process modelling:** Introduction of technology computer aided design (TCAD) tool emphasis on process. Various process technology like etching, photolithography, deposition, and masking models and tools	**6**	**CO2**
III	**High Bandgap Semiconductor Device modelling :** Introduction of technology computer aided design (TCAD) tool emphasis on electrical properties. IV and CV curves determination. Power and RF parameter analysis. 9 steps of device modelling. These 9 steps are abbreviated as SQEBASTIP where S stands for structure and characteristics to scale Q for qualitative model E and B for equations and boundary conditions A and S for approximations and solution, T for testing of the solution and I for improvement and finally P for parameter extraction.	**10**	**CO3**
IV	**Analytical modelling of the device** Physics equation based modelling, solution of Schrodinger and Poisson equation solution. Use of matlab or any mathematical tool for the demonstration of analytical model.	**6**	**CO4**
V	**Empirical modelling and LUT based model of the device:** Fundamental of empirical model and LUT based model. Implementation of these models in the circuit simulator like ADS or Cadence tool.	**6**	**CO4**
	Total Hours	**36**	

Essential Readings

1. M. Lundstrom,"Fundamentals of Carrier Transport", Cambridge University Press, 2nd Edition, 2000.
2. C.Snowden,"Introduction to Semiconductor Device Modeling", World Scientific, 1st Edition,1998.

Supplementary Readings

1. B.J Baliga, Wide Bandgap Semiconductor Power Devices: Materials, Physics, Design, and Applications, Woodhead Publishing, 1st Edition, 2019.
2. Y. Tsividis and C. McAndrew, "MOSFET modeling for Circuit Simulation", Oxford University Press, 1st Edition, 2011.