 National Institute of Technology Meghalaya An Institute of National Importance		**CURRICULUM**

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2019-2020**
Department	**Computer Science and Engineering**	Semester	**V**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CS 321	**Formal Verification**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes		
	To understand the fundamental concepts of formal verification		CO1	Able to understand the fundamental concept of formal verification
	To demonstrate the modeling of sequential systems, linear time properties, linear temporal logic, computation tree logic, model checking CTL and model checking LTL		CO2	Able to demonstrate the modeling of sequential systems, linear time properties, linear temporal logic
	To explain binary decision diagrams, symbolic model checking, model checking with SAT, bounded model checking, craig interpolation		CO3	Able to explain computation tree logic, model checking CTL and model checking LTL
	To understand decision procedures in model checking, practical industrial-scale verification		CO4	Able to demonstrate binary decision diagrams, symbolic model checking
			CO5	Able to demonstrate model checking with SAT, bounded model checking, craig interpolation
			CO6	Able to explain decision procedures in model checking, practical industrial-scale verification

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	0	0	0	0	0	0	2	0	0	0	3	0	3
2	CO2	3	3	3	1	2	0	0	0	1	0	0	0	2	3	2
3	CO3	1	2	3	3	2	2	0	0	0	0	0	0	2	3	3
4	CO4	1	2	3	3	3	2	3	0	2	0	0	1	2	3	2
5	CO5	2	3	3	2	2	3	2	0	2	0	0	1	3	3	3
6	CO6	1	2	3	3	3	2	3	0	2	0	0	1	2	3	2

SYLLABUS			
No.	Content	Hours	COs
I	**Introduction to Formal Verification**	**02**	**CO1**
II	**Modelling sequential systems as labelled transition systems (Kripke structures), Linear time properties, Linear temporal logic (LTL).**	**06**	**CO2**
III	**Computation tree logic (CTL) and CTL* , Model checking CTL , Model checking LTL**	**06**	**CO3**
IV	**Counterexamples and witnesses, Binary decision diagrams (BDD), Symbolic model checking**	**06**	**CO4**
V	**Model checking with SAT, bounded model checking, Completeness thresholds and k-induction, Craig interpolation**	**08**	**CO5**
VI	**Equivalences and abstractions, Decision procedures in model checking, Practical, industrial-scale verification, present challenges**	**08**	**CO6**
Total		**36**	

Essential Readings

1. *Principles of Model Checking*, by C. Baier and J.-P. Katoen, The MIT Press, 2008 edition.

2. *Model Checking*, by Edmund M. Clarke, Jr., Orna Grumberg, and Doron A. Peled, The MIT Press, 2nd edition, 2000.

3. *Logic in Computer Science: Modelling and reasoning about systems*, by Michael Huth and Mark Ryan, Cambridge University Press, 2nd edition, 2004.

Supplementary Readings

1. *Introduction to Formal Hardware Verification*, by Thomas Kropf, Springer, 1999 edition.

2. *Formal Hardware Verification: Methods and Systems in Comparison*, Ed. by Thomas Kropf, Springer, 1997 edition.

3. *Advanced Formal Verification*, by Rolf Drechsler, Springer, 2004 edition.