BONAM VENKATA CHALAMAYYA INSTITUTE OF TECHNOLGY & SCIENCE
(AUTONOMOUS)
(Approved by AICTE, Permanently Affiliated to JNTUK, Kakinada, Accredited by NAAC with 'A' Grade)
DEPARTMENTOFELECTRONICS AND COMMUNICATIONENGINEERING

PROFESSIONAL ELECTIVE-III

I YEAR II SEMESTER					
D25257A1	MEMS & NEMS	L	T	P	C
		3	0	0	3

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Understand the principles and processes involved in micro-fabrication techniques used for MEMS structures	K2
CO2	Analyze material behavior under mechanical stress and apply elasticity theory to MEMS structures like beams, cantilevers, and plates	K4
CO3	Model and evaluate MEMS capacitive switches and actuators, including electromechanical behavior, damping, and reliability aspects	K3
CO4	Design and assess MEMS-based thermal sensors and explore challenges in Bio-MEMS applications	K5
CO5	Understand and evaluate the design and operation of optical MEMS devices such as 2-D and 3-D switches	K2

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	L	M	H	H	H
CO2	M	L	M	H	M	H
CO3	M	L	M	H	M	H
CO4	H	L	H	H	M	M
CO5	M	L	M	M	H	M

Unit	Syllabus	Contact Hours
UNIT I	Introduction to Micro-Fabrication: Cleaning, Oxidation, Diffusion, Mask Making, Lithography, Etching, Ion Implantation, Chemical Vapor Deposition (CVD), Physical Vapor Deposition (PVD), Metallization. Surface Micromachining and Bulk Micromachining, Deep Reactive Ion Etching (DRIE), LIGA Process, Fabrication of High Aspect Ratio Deformable Structures.	12
UNIT II	Elasticity in Materials: Stress and Strain Calculations, Normal and Shear Strains, Constitutive Relations, Plane Stress, Biaxial Stress, Residual Stress, Energy Relations. Load-Deflection Calculations in Beams and Cantilevers (Rectangular Cross Section), Elastic Deformation in Square Plates, Resonant Frequency Calculations using Rayleigh-Ritz Method.	12
UNIT III	MEMS Capacitive Switch and Actuators: Lumped Model of MEMS Capacitive Switch, Pull-in Voltage, Electromechanical Deflection Modelling, Pull-in Instability, Switching Time and Pull-in Voltage	12

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	Scaling, Physical Effects in Nanoscale Gap-Size, Squeeze-Film Damping, Perforated MEMS Capacitive Switch. Comb Actuators, Accelerometer, Pressure Sensor. Energy Approach: Lagrangian Mechanics Applied to MEMS Capacitive Switches. Reliability Issues in RF MEMS Capacitive Switches.	
UNIT IV	MEMS Sensors: Thermal Sensors, Interaction of Thermal-Electrical Fields, Numerical Design of Thermal Sensors. Introduction to Bio-MEMS and Associated Design Challenges.	12
UNIT V	Optical MEMS: 2-D and 3-D Optical MEMS Switches, Design Examples and Case Studies.	12
	Total	60

REFERENCE BOOKS:

1. Rebeiz, G.M., *RF MEMS: Theory Design and Technology*, Wiley
2. Stephen D. Senturia, *Microsystem Design*, Kluwer Academic
3. Madou, M., *Fundamentals of Microfabrication*, CRC Press
4. Sandana A., *Engineering Biosensors: Kinetics and Design Applications*, Academic Press

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