SRM ACD

SRM Institute of Science and Technology
College of Engineering and Technology
Department of Electronics and Communication Engineering

Academic Course Description (ACD)

(21ECC201T/ Solid State Devices – III Semester)

Vision of the Department

1. To create and disseminate knowledge in the area of Electronics and Communication engineering through national and international accredited educational process.
2. To facilitate a unique learning and research experience to the students and faculty.
3. To prepare the students as highly ethical and competent professionals.

Mission of the Department

1. Build an educational process that is well suited to local needs as well as satisfies the national and international accreditation requirements.
2. Attract the qualified professionals and retain them by building an environment that fosters work freedom and empowerment.
3. With the right talent pool, create knowledge and disseminate, get involved in collaborative research with reputed universities and produce competent graduands.

Program Educational Objectives (PEO)

Program Educational Objectives (PEO) for the Electronics and Communication Engineering program describes accomplishments that graduates are expected to attain within a few years of graduation.

Graduates will be able to

PEO1: Establish themselves as successful and creative practicing professional engineers both nationally and globally in the related fields of Electronics and Communication Engineering.

PEO2: Apply the acquired knowledge and skills in solving real-world engineering problems; develop novel technology and design products, which are economically feasible and socially relevant.

PEO3: Develop an attitude of lifelong learning for sustained career advancement and adapt to the changing multidisciplinary profession.

PEO4: Demonstrate leadership qualities, effective communication skills, and to work in a team of enterprising people in a multidisciplinary and multicultural environment with strong adherence to professional ethics.

Year/ Semester : II/ III

Academic Year : 2023-24 (Odd)

Course Code & Title : 21ECC201T / Solid State Devices

1. **Course description:**

   The purpose of learning this course is to acquire knowledge on theoretical concepts and analysis techniques to find solutions for problems related to Electronic Devices and circuitry for various applications.

2. **Core Course/ Department Professional Elective Course /Open Elective Course: Core course**
3. **Credit hours : 3**
4. **Course coordinator(s): Dr. Sanjay Kumar Shau**
5. **Course Teachers:**

Name of the Course Teachers	Office location	Email: @srmist.edu.in	Consultation Hours
Dr. K. Suganthi	TP1014	suganthk	DO – 3 3:00 to 4:00
Dr. Ferents Koni Jiavana	TP1010	frentesk	DO – 1 3:10 to 4:50
Mr. B. Muthukumaran	TP1015	muthukub1	DO - 3 1:35 to 03:10
Mrs. N. Veni	TP1006A	venin	DO – 4 12:30 to 1:00
Dr. Arijit Bardhan Roy	TP1015	arijitbr	DO – 1 9:45 to 10:35
Dr. Sanjay Kumar Sahu	TP1015	sanjayks2	DO -2 3:10 to 4:50
Dr. J. K. Kasthuri Bha	TP1010	kasthurij	DO – 2 2:20 to 4:00
Dr. Mohammed Jawaid Alam	TP1106A	mdjawaia	DO – 4 10:40 to 11:30
Mr. T. Saminathan	TP1103A	saminatt	DO -4 11:30 to 12:30
Dr. P. Sudhanya	TP903A	sudhanyp	DO – 5 12:30 to 1:30
Dr. Manish Verma	TP1015	manishv	DO – 4 03:10 to 4:50

6. Relationship to other courses

Pre-requisites : Nil

Assumed knowledge : Nil

Following courses : Nil

7. Course Articulation Matrix

	18ECC102J - ELECTRONIC DEVICES	PROGRAM LEARNING OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
S. NO	COURSE LEARNING OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	Comprehend the basic properties of semiconductors and PN junction.	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-
2	Analyze and experiment applications of special diodes and PN diode.	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-
3	Articulate the construction, operation, characteristics and parameters of Bipolar Junction transistor and its applications.	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-
4	Demonstrate construction, operation, characteristics and parameters of Field Effect Transistor and its application.	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-
5	Explain the fabrication techniques of semiconductor devices in integrated circuits.	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-

8. Program Outcomes (PO)

PO1 - Engineering knowledge

Apply the knowledge of Mathematics, Science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.

PO2 - Problem analysis

Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design/development of solutions

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 - Conduct investigations of complex problems

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 - Modern tool usage

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 - The engineer and society

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 - Environment and sustainability

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 - Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 - Individual and team work

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - Communication

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 - Project management and finance

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 - Life-long learning

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

9. Target value for CO, PO attainment

21ECC201T – Solid State Devices		Target Value
Sl. No	Course Outcome	
1	Comprehend the basic properties of semiconductors and PN junction.	2.1
2	Analyze and experiment applications of special diodes and PN diode.	2.2
3	Articulate the construction, operation, characteristics and parameters of Bipolar Junction transistor and its applications.	2.1
4	Review field-effect transistor construction, operation, characteristics and parameters, as well as its application in amplification and	2.1
5	Demonstrate construction, operation, characteristics and parameters of Field Effect Transistor and its application.	2.1
	Program Outcome	
1	PO1 – Engineering Knowledge	2.1
2	PO2 – Problem Analysis	2.1
3	PO12 – Life-Long learning	2.1

10. Learning Resources

Text books / Other reading materials	
1.	Ben G. Streetman and Sanjay Kumar Banerjee, "Solid State Electronic Devices Pearson, 7th edition, 2016.
2.	Donald A Neamen, Dhrubes Biswas "Semiconductor Physics and Devices", 4th edition, McGraw-Hill Education, 2012.
3.	Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education, 11th Edition, 2013.
4.	R. S. Sedha, "Applied Electronics", S. Chand, 2018.
5	David A. Bell, "Electronic Devices and Circuits", 5th edition, Oxford University Press, 2015.
6	Muhammad Rashid, "Microelectronic Circuits: Analysis & Design", 2nd edition, Cengage Learning, 2010.
7	Thomas L. Floyd, "Electronic Devices", Pearson, 9th edition, 2013.

11. Professional component

Broad area : Electronics

12. Session Plan

Learning Unit/ Module	Session	Description of Topics	No. of Contact hours	CO	PO	BL	Referen -ces
I Semi-conductor Junction Theory	1	Semiconductor, Fermi level, Electron and hole concentration at equilibrium, Problem solving	1	1	1,2, 12	1,2,3	1,2,4,5
	2	Temperature dependence of charge carriers, Drift and diffusion of carriers	1	1	1,12	1,2	1,2,4,5
	3	Hall effect and problem solving	1	1	1,2,12	2,3,4	1,2,4,5
	4	PN junction theory: Current-Voltage relationship, Problem solving	1	1	1,2,12	1,2,3	1,2,4,5
	5	Calculation of depletion width, potential barrier and diode current, Problem solving	1	1	1,2,12	2,3,4	1,2,4,5
	6	Capacitive effects in PN junction, Energy band structure	1	1	1,12	1,2	1,2,4,5

	7	Terminal characteristics of PN diode and various parameters	1	1	1,12	1,2	1,2,4,5
	8	Diode modelling	1	1	1,12	1,2	1,2,4,5
	9	DC load line and analysis, Problem solving	1	1	1,2,12	1,2,3	1,2,4,5
II Special Junction Diode and PN applications	10	Zener diode, Varactor diode	1	2	1,12	1,2	1,2,4,5
	11	Step recovery diode, Tunnel diode	1	2	1,12	1,2	1,2,4,5
	12	LED, Laser diode	1	2	1,12	1,2	1,2,4,5
	13	Pin photodiode, Avalanche Photodiode	1	2	1,12	1,2	1,2,4,5
	14	Half wave rectifier: Operation and derivation of average values of output voltage and current, ripple factor and efficiency, PIV, TUF, Problem Solving	1	2	1,2,12	2,3,4	1,2,4,5
	15	Full wave rectifier: Operation and derivation of average values of output voltage and current, ripple factor and efficiency, PIV, TUF, Problem Solving	1	2	1,2,12	2,3,4	1,2,4,5
	16	Bridge rectifier: Operation and derivation of average values of output voltage and current, ripple factor and efficiency, PIV, TUF, Problem Solving	1	2	1,2,12	2,3,4	1,2,4,5
	17	Filters: Inductor and capacitor filters, LC and CLC Filters	1	2	1,12	1,2	1,2,4,5
	18	Clippers and Clampers, Voltage Multipliers, Problem Solving	1	2	1,2, 12	2,3,4	1,2,4,5
III Bipolar Junction Transistor	19	Physical structure and device operation of BJT	1	3	1,12	1,2	2,3,5,6
	20	Current-Voltage characteristics of BJT configurations (CE and CB mode)	1	3	1,12	1,2	2,3,5,6
	21	Current-Voltage characteristics of BJT configurations (CC mode), Early effect	1	3	1,12	1,2	2,3,5,6

	22	BJT circuit models: Ebers Moll and Gummel Poon model	1	3	1,12	1,2	2,3,5,6
	23	BJT circuit models: Small signal and hybrid-π model	1	3	1,12	1,2	2,3,5,6
	24	BJT Biasing: Base bias and Emitter bias, Problem Solving	1	3	1,2,12	2,3,4	2,3,5,6
	25	BJT Biasing: Voltage-divider bias and Collector-feedback bias, Problem Solving	1	3	1,2,12	2,3,4	2,3,5,6
	26	BJT as an amplifier, Problem solving	1	3	1,2,12	2,3,4	2,3,5,6
	27	BJT as a Switch, Problem Solving	1	3	1,2,12	2,3,4	2,3,5,6
IV Field Effect Transistor	28	Physical Structure, Device operation and I-V characteristics of D-MOSFET	1	4	1,12	1, 2	2,3,5,6
	29	Physical Structure, Device operation and I-V characteristics of E-MOSFET	1	4	1,12	1,2	2,3,5,6
	30	Derivation of drain current and Transconductance of E and D-MOSFET	1	4	1,12	1,2	2,3,5,6
	31	Biasing circuits for MOSFET: Gate bias, Self-bias, Problem Solving	1	4	1,12	2,3,4	2,3,5,6
	32	Biasing circuits for MOSFET: Voltage divider bias, Problem Solving	1	4	1,12	2,3,4	2,3,5,6
	33	MESFET, HEMT, CMOSFET	1	4	1,12	1,2	2,3,5,6
	34	MOSFET as an amplifier, Problem Solving	1	4	1,2,12	2,3,4	2,3,5,6
	35	MOSFET as a switch, Problem Solving	1	4	1,2,12	2,3,4	2,3,5,6
	36	FET Models	1	4	1,12	1,2	2,3,5,6
V Fabrication of Semicondu-ctor Devices	37	Integrated Circuit: Advantages, Limitations	1	5	1,12	1,2	1,5
	38	Integrated Circuit: Classification	1	5	1,12	1,2	1,5
	39	IC Manufacturing: Material Preparation	1	5	1,12	1,2	1,5

	40	Crystal Growing and wafer preparation	1	5	1,12	1.2	1.5
	41	Wafer fabrication	1	5	1,12	1.2	1.5
	42	Testing, Bonding and Packaging	1	5	1,12	1.2	1.5
	43	Fabrication of PN diode	1	5	1,12	1.2	1.5
	44	Fabrication of BJT	1	5	1,12	1.2	1.5
	45	Fabrication of MOSFET	1	5	1,12	1.2	1.5

13. Assessment

Continuous Internal Evaluation				End Semester Exam (40% weightage)
CLA-1			CLA-2	
CLA 1A		CLA 1B	CLA 1C	
Theory (CT1)	Theory (CT2)	Theory (CT3)	Theory	Theory
10 Marks	20 Marks	20 Marks	Average of 2 Assignments: 5 Marks Surprise Test: 5 Marks	40 Marks

14. Continuous Internal Evaluation Schedule

Sl. No.	CIE	Schedule
1	Assignment 1	02.08.2023
2	CLA T1	09.08.2023
3	Assignment 2	21.09.2023
4	CLA T2	29.09.2023
5	Surprise Test	25.10.2023
6	CLA T3	01.11.2023

15. Rubrics for Evaluation

RUBRICS				
21ECC201T / Solid State Devices	**PO1- Engineering Knowledge** **PO2- Problem Analysis** **PO12 – Life-long learning**			
CO	**Competency**	**Below expectations**	**Marginal**	**Above expectations**
		< 50%	**50-79%**	**80 - 100%**
Comprehend the basic properties of semiconductors and PN junction.	Ability to distinguish between different materials and to understand various properties of semiconductor materials and PN Junction.	Could not identify a material type and interpret various properties of semiconductor materials.	Minor errors in interpreting various properties of semiconductor materials and PN Junction thereby.	Accurate understandings of semiconductor properties and able to apply the concepts PN Junctions
Analyze and experiment applications of special diodes and PN diode.	Ability to analyze and experiment various applications of PN diode.	Cannot analyze and explain clearly about various applications of PN junction diode.	Incomplete understanding of various application of PN junction diode.	Accurate analysis and understanding of various applications of PN junction diode.
Articulate the construction, operation, characteristics and parameters of Bipolar Junction transistor and its applications.	Ability to understand various structural properties and characteristics of BJT and apply them for various applications.	Cannot clearly explain the structural properties and characteristics of BJT.	Understand the phenomenon of guided wave propagation and its mode of propagation.	Clear understanding on the phenomenon of guided wave propagation and its mode of propagation.
Demonstrate construction, operation, characteristics and parameters of Field Effect Transistor and its application.	Ability to understand various structural properties, operation and characteristics of FET and apply them for various applications.	Lack of understanding various structural properties, operation and characteristics of FET.	Minor understanding various structural properties, operation and characteristics of FET.	Clearly understand various structural properties, operation and characteristics of FET and able to use them for various applications.
Explain the fabrication techniques of semiconductor devices in integrated circuits.	Ability to understand the various steps involved in the fabrication of semiconductor devices in integrated circuits.	Cannot clearly explain various steps involved in the fabrication of semiconductor devices in integrated circuits.	Understands and explain various steps involved in the fabrication of semiconductor devices in integrated circuits.	Understands, explain and implement (if required) various steps involved in the fabrication of semiconductor devices in integrated circuits.

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Prepared by: Dr. Sanjay Kumar Sahu

Date: 14.07.2023 **Revision Number:00** **Date of Revision:00**

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Sl. No.	Name of the Faculty	Signature
1	Dr. K. Suganthi	
2	Dr. Ferents Koni Jiavana	
3	Mr. B. Muthukumaran	
4	Mrs. N. Veni	
5	Dr. Arijit Bardhan Roy	
6	Dr. Sanjay Kumar Sahu	
7	Dr. J. K. Kasthuri Bha	
8	Dr. Mohammed Jawaid Alam	
9	Mr. T. Saminathan	
10	Dr. P. Sudhanya	
11	Dr. Manish Verma	

19/7/23

Course Coordinator

Dr. S. K. Sahu

19/7/2023

Academic Advisor/ Coordinator

Dr. C.T. Manimegalai / Dr. Krithiga S

Professor In-Charge

Dr. Rama Rao T

19/7/23.

Head of Department

Dr. Shanthi Prince