**ACD**

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College of Engineering and Technology Department of Electronics and Communication Engineering

# Academic Course Description (ACD)

(**Subject code/ Title: 21ECC202T- Analog and Linear Electronic Circuits - Semester: IV**)

## **Vision of the Department**

To establish itself as a leading benchmark in the field of electronics and communication engineering by providing high-quality educational and research opportunities that align with advancing technology, while nurturing the development of ethical and skilled professionals.

## **Mission of the Department**

1. To consistently uphold the highest standards of educational process aimed at imparting knowledge and skills related to electronic design and communication engineering fostering successful practicing engineers nationally and globally
2. To stay at the forefront of technological advancements and adapt our programs to provide cutting-edge learning experiences through collaborative research and innovation in the electronics, communication, and interdisciplinary fields through interaction with research institute and industry to align with the evolving demands of society.
3. To attract qualified professionals in a rewarding way and enable them to foster the growth of individuals as good leaders, technocrats, entrepreneurs who are technically skilled and committed to ethical principles in their professional endeavors.
4. **Program Educational Objectives (PEO)**

Graduates within 4 years of graduation will / should demonstrate:

**PEO - 1** Apply the acquired knowledge and skills in solving real-world engineering problems, considering national/global and societal issues such as health, environment, and safety.

**PEO - 2** Create technologically innovative products that are economically viable and socially relevant.

**PEO - 3** Develop an attitude toward pursuing knowledge and advanced education for sustained career advancement to adapt to emerging fields.

**PEO - 4** Demonstrate leadership qualities and effective communication skills to work in a team of enterprising people in a multidisciplinary and multicultural environment with strong adherence to professional ethics.

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**Year/ Semester : II/IV**

**Academic Year : 2023-2024 (EVEN)**

**Course Code & Title : 21ECC202T- Analog and Linear Electronic Circuits**

1. **Course (catalog) description:**

The purpose of learning this course is to understand the concepts of single stage amplifier, Multi stage amplifier, internal structure of opamp IC741, types of feedback amplifiers and Know about Functions of oscillators and applications of linear IC.

1. **Professional Core**
2. **Credit Hours :** 3
3. **Course coordinator(s):** Dr. M.K. Srilekha
4. **Course Teachers:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of the Course Teachers** | **Office location** | **Email**  (@srmist.edu.in) | **Consultation Hours** |
| Dr. A.V. Manikandan | TP1212 | manikanm@srmist.edu.in | DO5:1:00-2:00 |
| Dr. A. Lavanya | TP903A | lavanyaa1@srmist.edu.in | DO4:11:00-12:00 |
| Dr. S. Sunithamani | TP1203A | sunithas@srmist.edu.in | DO4-11:00-12:00 |
| Dr. Adithya Nath Bhatt | TP1103A | adityanb@srmist.edu.in | DO5: 10:30-11:30 |
| Dr. B. Vasudevan | TP1106A | vasudevb@srmist.edu.in | DO4:2:00-3:00 |
| Dr. M.K. Srilekha | TP1217 | srilekhm@srmist.edu.in | DO4:11:00-12:00 |
| Dr. Arjith Bhardhan Roy | TP1015 | arijitbr@srmist.edu.in | DO4: 4:00-4:50 |
| Dr. Tulika Srivastava | TP1003A | tulikas@srmist.edu.in | DO1: 11:00-12:00 |
| Dr. Pawan Kumar | TP1015 | pawank@srmist.edu.in | DO5:3:00-4:00 |
| Dr. M. Jenath | TP1203A | jenathm@srmist.edu.in | DO2:2:00-3:00 |

1. **Relationship to other courses**

Pre-requisite Courses: Nil

Co-requisite Courses: Nil Progressive Courses: Nil

1. **Course Articulation Matrix**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **21ECC202T- Analog and Linear Electronic Circuits** | **PROGRAM OUTCOMES (PO)** | | | | | | | | | | | | **PROGRAM SPECIFIC OUTCOMES** | | |
| **S.NO** | **COURSE LEARNING OUTCOMES** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| 1 | Apply the small signal equivalent circuit in the analysis of single and multistage transistor amplifier circuits | 2 | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - | **3** |
| 2 | Infer the DC and AC characteristics of operational amplifier | 2 | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 3 | Classify and identify the suitable feedback topologies and oscillators as per application | 2 | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 4 | Elucidate and design linear and non-linear applications of op-amp | 2 | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 5 | Illustrate the function of application specific ICs | 2 | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - | 3 |

1. **Program Outcomes (PO), PO-SO Mapping, and Program Criteria**

**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 the first principles of mathematics, natural sciences, and engineering sciences.

**PO2- Design Development of solutions**

**Mapping between Program Outcomes (PO) and Student Outcomes (SO)**

|  |  |
| --- | --- |
| **NBA- Program Outcomes (PO)** | **Student Outcomes (SO) EAC, ABET** |
| **PO1 Engineering knowledge**  **PO2 Problem Analysis**:  **PO3 Design development of solutions** | **SO3** An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics |

**Program Criteria**

The Program Criteria of B.Tech. Electronics and Communication Engineering program is listed below.

**PC3:** Sciences (defined as biological, chemical, or physical science)

**PC4:** Engineering topics (including computing science) necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.

1. **Target value for CO, PO attainment**

|  |  |  |
| --- | --- | --- |
| **21ECC202T Analog and Linear Electronic Circuits** | | **Target Value** |
| **S.No.** | **Course Outcome** |
| 1 | Apply the small signal equivalent circuit in the analysis of single and multistage transistor amplifier circuits | 2.1 |
| 2 | Infer the DC and AC characteristics of operational amplifier | 2.1 |
| 3 | Classify and identify the suitable feedback topologies and oscillators as per application | 2.1 |
| 4 | Elucidate and design linear and non-linear applications of op-amp | 2.1 |
| 5 | Illustrate the function of application specific ICs | 2.1 |
|  | **Program Outcome** |  |
| 1 | PO1- Engineering Knowledge | 2.1 |
| 2 | PO2- Problem analysis | 2.1 |
| 3 | PO3-Design Development of solutions | 2.1 |

1. **Learning Resources**

|  |  |
| --- | --- |
| **Textbooks / Other reading materials** | |
| **1.** | David A. Bell, “Electronic Devices and Circuits”, 5th ed., Oxford University Press, 2015 |
| **2.** | Donald Neaman, “Electronic Circuits: Analysis and Design”, 3rd ed., Mc-Graw-Hill Education, 2011 |
| **3.** | Muhammad Rashid, “Microelectronic Circuits: Analysis and Design”, 2nded., Cengage Learning, 2010 |
| **4.** | Robert L. Boylestad Louis Nashelsky, “Electronic Devices and Circuit Theory”, 11th ed., Pearson Education, 2013 |
| **5.** | D. Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, 5th ed., New Age International Pvt. Ltd., 2015 |
| **6.** | Ramakant A. Gayakwad, “Op-amp and Linear ICs”, 4th ed., Printice Hall/Pearson, Education,2015 |
| **7.** | Sergio Franco, “Design with Operational amplifiers and Analog Integrated circuits”, 4th ed., Tata McGraw-Hill, 2016 |

1. **Professional component Broad area: Electronics**
2. **Session Plan**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Learning Unit/**  **Module** | | **Session** | | **Description of Topic (Theory)** | **No. of**  **Contact hours** | **CO** | **PO** | | **BL** | **Reference** |
| **Unit-1** | | **S1** | | Bipolar linear amplifier, load line analysis | **1** | **1** | **1,2** | | **1,2** | **1,2** |
| **S2** | | Small signal analysis, Analysis of common emitter amplifier | **1** | **1** | **1,2** | | **1,2,3** | **1,2** |
| **S3** | | Analysis of common base and common collector amplifier | **1** | **1** | **1,2** | | **1,2,3** | **1,2** |
| **S4** | | Multi stage amplifier, cascade amplifier cascode and Darlington amplifier using hybrid π model | **1** | **1** | **1,2** | | **1,2,3** | **1,2** |
| **S5** | | Low and high frequency response of BJT amplifier | **1** | **1** | **1,2** | | **1,2,3** | **1,2** |
| **S6** | | MOSFET linear amplifier, load line analysis, small signal model | **1** | **1** | **1,2** | | **1,2,3** | **1,2** |
| **S7** | | Analysis of common source amplifier common gate amplifier using hybrid π model | **1** | **1** | **1,2** | | **1,2** | **1,2** |
| **S8** | | common drain amplifier using hybrid π model | **1** | **1** | **1,2** | | **1,2** | **1,2** |
| **S9** | | Low and high frequency analysis of MOSFET amplifier | **1** | **1** | **1,2** | | **1,2** | **1,2** |
| **Unit-2** | | **S1** | | BJT differential amplifier with active and passive load | **1** | **2** | **1,2** | | **1,2,3** | **1,2** |
| **S2** | | MOSFET differential amplifier with active and passive load | **1** | **2** | **1,2** | | **1,2,3** | **1,2** |
| **S3** | | Internal structure of opamp | **1** | **2** | **1,2** | | **1** | **2,3** |
| **S4** | | Output stages and power amplifier | **1** | **2** | **1,2** | | **1** | **2,3** |
| **S5** | | Class A and Class AB amplifier | **1** | **2** | **1,2** | | **2,3** | **2,3** |
| **S6** | | Push pull complementary amplifier configuration, Ideal operational amplifier | **1** | **2** | **1,2** | | **1,2,3** | **2,3** |
| **S7** | | IC741 package, characteristics of opamp | **1** | **2** | **1,2** | | **1** | **3,5** |
| **S8** | | Open loop configuration, Non ideal effects in opamp | **1** | **2** | **1,2** | | **1,2** | **3,5** |
| **S9** | | Frequency response of opamp | **1** | **2** | **1,2** | | **1,2,3** | **3,5** |
| **Unit-3** | | **S1** | | Introduction to feedback amplifier and types, Advantages and disadvantages of negative feedback | **1** | **3** | **1,2** | | **1,2,3** | **1,2,3** |
| **S2** | | Basic feedback concepts, feedback topologies, ideal feedback topologies, Voltage shunt-series amplifier | **1** | **3** | **1,2** | | **1,2,3** | **1,2,3** |
| **S3** | | Current shunt series amplifier, Transconductance amplifier series-series | **1** | **3** | **1,2,3** | | **1,2,3** | **1,2,3** |
| **S4** | | Transresistance amplifier shunt shunt | **1** | **3** | **1,2,3** | | **1,2,3** | **1,2,3** |
|  | | **S5** | | Stability analysis of feedback circuit (BJT/MOSFET/opamp) | **1** | **3** | **1,2,3** | | **1,2,3** | **1,2,3** |
|  | | **S6** | | Principle of oscillation | **1** | **3** | **1,2** | | **1,2,3** | **1,2,3** |
|  | | **S7** | | RC, LC and crystal oscillator using BJT | **1** | **3** | **1,2,3** | | **1,2,3** | **1,2,3** |
|  | | **S8** | | RC, LC and crystal oscillator using BJT | **1** | **3** | **1,2,3** | | **1,2** | **1,2,3** |
|  | | **S9** | | RC, LC and crystal oscillator using opamp | **1** | **3** | **1,2,3** | | **1,2** | **1,2,3** |
| **Unit-4** | **S1** | | Summing amplifier, subtractor | | **1** | **4** | | **1,2,3** | **1,2,3** | **3,5** |
| **S2** | | Integrator, Differentiator | | **1** | **4** | | **1,2,3** | **1,2,3** | **3,5** |
| **S3** | | Difference amplifier, Instrumentation amplifier | | **1** | **4** | | **1,2,3** | **1,2,3** | **3,5** |
| **S4** | | Voltage to current converter, Current to voltage converter | | **1** | **4** | | **1,2,3** | **1,2,3** | **3,5** |
| **S5** | | Comparators, Schimitt trigger | | **1** | **4** | | **1,2,3** | **1,2,3** | **3,5** |
| **S6** | | Non sinusoidal oscillator, Active filters | | **1** | **4** | | **1,2,3** | **1,2,3** | **3,5** |
| **S7** | | first order and second order low pass and high pass filter | | **1** | **4** | | **1,2,3** | **1,2,3** | **3,5** |
| **S8** | | Band pass and Band stop filter | | **1** | **4** | | **1,2,3** | **1,2,3** | **3,5** |
| **S9** | | Waveform generators square wave and sine wave generators | | **1** | **4** | | **1,2,3** | **1,2,3** | **3,5** |
| **Unit-5** | **S1** | | Weighted resistor Digital to Analog converter | | **1** | **5** | | **1,2,3** | **1,2** | **3,5** |
| **S2** | | R- 2R Digital to Anaolg converter | | **1** | **5** | | **1,2,3** | **1,2,3** | **3,5** |
| **S3** | | Successive approximation analog to digital converter | | **1** | **5** | | **1,2,3** | **1,2,3** | **3,5** |
| **S4** | | Precision rectifier Half wave and full wave rectifier | | **1** | **5** | | **1,2,3** | **1,2,3** | **3,5** |
| **S5** | | Clipper and clamper | | **1** | **5** | | **1,2,3** | **1,2,3** | **3,5** |
| **S6** | | IC555 timer functional block diagram | | **1** | **5** | | **1,2** | **1,2** | **3,5** |
| **S7** | | IC566 Voltage controlled oscillator, IC 565 Phase locked loop | | **1** | **5** | | **1,2** | **1,2** | **3,5** |
| **S8** | | Applications of PLL, Timer | | **1** | **5** | | **1,2** | **1,2** | **3,5** |
| **S9** | | Voltage regulator LM78xx, LM79xx, LM723, LM780 power amplifier | | **1** | **5** | | **1,2** | **1,2** | **3,5** |

1. **Assessment**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Continuous Internal Evaluation (60% weightage)** | | | | **Semester End**  **Exam (40% weightage)** |
| **CLA-1 (50% weightage)** | | | **CLA-2 (10% weightage)** |
| **Theory** | | | **Theory** | **Theory** |
| **CLA 1A** | | |
| CT-1 | CT-2 | CT-3 |
| 20 marks | 20 marks | 20 marks | 10 marks | 40 marks |

**Rubrics for Evaluation**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **RUBRICS** | | | | |
| **21ECC202T-**  **Analog and Linear Electronic circuits** | **PO1-Engineering Knowledge PO2- Problem analysis**  **PO3- Design development of solutions** | | | |
| CO | **Competency** | **Below expectations** | **Marginal** | **Exceed expectations** |
| **< 50%** | **50-79%** | **80 - 100%** |
| Apply the small signal equivalent circuit in the analysis of single and multistage transistor amplifier circuits | To study the concepts of small signal circuit single stage and multistage amplifier | Could not Interpret the concepts of single stage and multistage | Minor errors in interpret the concepts of single stage and multistage amplifier | Accurate understandings of the concepts and able to apply the concepts of Computer hardware |
| Infer the DC and AC characteristics of operational amplifier | To review the concepts of DC and AC characteristics of opamp | Cannot explain clearly about DC and AC characteristics of opamp | Incomplete understanding of DC and AC characteristics of | Accurately understanding and Analyzing the concepts of DC and AC characteristics of opamp |
| Classify and identify the suitable feedback topologies and oscillators as per application | To classify the detailed operation of Basic Processing units and the performance of Pipelining | Cannot clearly explain the detailed operation of Basic Processing units and the performance of Pipelining | Understand the phenomenon of detailed operation of Basic Processing units and the  performance of Pipelining. | Clear understanding on the phenomenon of detailed operation of Basic Processing units and the performance of Pipelining. |
| Elucidate and design linear and non-linear applications of op-amp | To explore linear and non linear opamp applications | Lack of understanding the concept of linear and non linear applications of opamp | Minor understands the concept of linear and non linear applications of opamp | Understand the concept of linear and non linear applications of opamp |
| Illustrate the function of application specific ICs | To interpret functions of application specific IC | Cannot clearly explain the concepts of application specific IC | Understands the concepts application specific IC | Can understand the concepts of application specific IC |

1. **Continuous Internal Evaluation Schedule**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S. No.** | **CIE** | | | **Schedule** |
| 1 | CLA-1 | CLA 1A | CT-1 | 20.02.2024 |
| CT-2 | 03.04.2024 |
| CT-3 | 06.05.2024 |

**Prepared by: Dr. M.K. Srilekha**

**Dated: Revision No.: Date of revision:**

|  |  |  |
| --- | --- | --- |
| **S.No** | **Name of the Course Teachers** | **Signature** |
| 1. | Dr. A.V. Manikandan |  |
| 2. | Dr. A. Lavanya |  |
| 3. | Dr. S. Sunithamani |  |
| 4. | Dr. Adithya Nath Bhatt |  |
| 5. | Dr. B. Vasudevan |  |
| 6. | Dr. M.K. Srilekha |  |
| 7. | Dr. Arjith Bhardhan Roy |  |
| 8. | Dr. Tulika Srivastava |  |
| 9. | Dr. Pawan Kumar |  |
| 10. | Dr. M. Jenath |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Coordinator** | **Academic Advisor/ Coordinator** | **Professor In-Charge** | **Head of Department** |
| Dr. M.K. Srilekha | Dr. C.T. Manimegalai /  Dr. Krithiga S | Dr. Rama Rao T | Dr. Shanthi Prince |