



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE03024031

Subject Name: Analog Electronics

w. e. f. Academic Year:	2024-25
Semester:	3
Category of the Course:	PCC- 01

Prerequisite	BE01000111 (Basic Electronics Engineering)
Rationale:	Today's world is working on digital devices. However, real world devices and signals are analog in nature. Analog electronic components and circuits are building blocks for any electronic device used in industries or in daily life. It is therefore necessary for electronics engineers to understand clearly the principles and functioning of the basic analogue

Course Outcome:

After Completion of the Course, the student will be able to:

No	Course Outcomes
01	Understand working of transistor circuits
02	Understand the characteristics of an ideal op amp.
03	Analyze commonly used OPAMP circuits
04	Compare various ADC and DAC circuits

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	TH		Theory		Tutorial / Practical			
						ESE (E)	PA (M)	PA/ (I)	PBL (I)	ESE (V)	
45	0	30	45	120	04	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction: Review of diode, types of diodes and diode applications, Characteristics, construction, biasing, types, symbols, circuit configurations, and comparison of configurations of BJT and FET.	4	10



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2.	Basic BJT amplifiers: Biasing schemes - Load line concept - Bias stability - working of CC, CE and CB configurations - RC coupled and transformer coupled multistage amplifiers — Thermal runaway in BJT amplifiers FET amplifiers: Biasing of JFET and MOSFET – working of common source, common drain and common gate amplifier configurations – Thermal runaway in MOS amplifiers Frequency response of amplifiers – Low frequency response of BJT and FET amplifiers	8	20
3.	Construction and working of Operational Amplifier: Concept, block diagram, circuits for input stage, intermediate stage, level translator, output stage, working of these circuits, Input difference amplifier and its biasing, constant current biasing, current mirror circuit. Standard OPAMP model, Electrical characteristics and parameters of OPAMP, input impedance, output impedance, slew rate, bandwidth, bias current, offset voltage, PSRR, CMRR etc., Practical OPAMP ICs like LM741	9	20
4.	OPAMP Basic Circuits: Concept of virtual short, concept of feedback, Inverting, non-inverting, difference amplifier, summing amplifier, working, input output relation, practical circuits, Design of these amplifier circuits, component selection, OPAMP packages	9	20
5.	OPAMP Applications Circuits: construction and working of Comparator, Instrumentation amplifier, Schmitz trigger, integrator, differentiator, V-I conversion , I-V conversion, Log-antilog amplifier, precision rectifier, OPAMP based clipper, clamper, oscillator, waveform generator etc., Design of simple circuits	9	20
6.	Special Circuits : ADC and DAC circuits: Types, block diagram, working principle, relative comparison of various ADC and DAC circuits. Timer LM 555: Construction, working and application circuits of LM555 timer IC Concept of Switched capacitor circuits.	9	10
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
40	20	20	20	0	0

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:



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(a) Books:

1. Electronics Devices and Circuits, David A. Bell, Prentice Hall
2. Op-amps and Linear Integrated Circuits, Ramakant A. Gaikwad, Fourth Edition, PHI
3. OP-Amps and Analog Integrated Circuits, Sergio Franco, Mc Graw Hill
4. Switched Capacitor Circuits, A. G. Bolton, BPB Publications

(b) Open source software and website:

1. <https://nptel.ac.in/>
2. [Virtual Labs](#)
3. [Understanding Operational Amplifier Specifications \(Rev. B\)](#)
4. [Handbook of Operational Amplifier Applications \(Rev. B\)](#)
5. [LM555 Timer datasheet \(Rev. D\)](#)

Suggested Course Practical List:

This list is suggestion only. The faculty can modify the list based on available resources.

1. Measurement of OPAMP parameters
2. Designing of an amplifier of given gain for an inverting and non-inverting configuration op-amp
3. Designing an analog adder and subtractor circuit
4. Study of precision rectifier.
5. Study of an integrator using op-amp.
6. Designing of a RC Phase shift oscillator using op-amp.
7. Designing a V-I converter using OPAMP
8. Designing an I-V converter using OPAMP
9. Study of IC 555 as an astable multivibrator.
10. Study of IC 555 as a monostable multivibrator.

• **List of suggested activities for Problem Based Learning:**

Sr. No.	Name of the activity	No. of hours	Evaluation Criteria
1	Interpretation of Datasheet of IC 741 and Analyze datasheets	Preparing report	Based on the understanding
2	Differential Amplifier, Multistage Amplifier and Power stage Amplifier circuit simulation using MATLAB	Use of MATLAB for circuit simulation	Based on the understanding and applying of MATLAB
3	Simulation of all Linear application of op-amp	Use of MATLAB for circuit simulation	Based on the type of application and explanation
4	Simulation of all Non- linear	Use of MATLAB for circuit simulation	Based on the type of application and explanation



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	application of op-amp		
5	Build circuits on a breadboard: all linear and non linear application of Op-amp	Any two linear and non linear applications of Op-amp.	Based on the circuit explanation and results.
6	Practice debugging of circuits, identifying faults in circuits using multimeters and oscilloscopes	One circuit for each debugging and fault identifying exercise	Based on the Skill.
7	Mini project: Design and implementation of any application of op-amp	Undertake a small home-based or simulation-based project (10 h)	Based on the understanding, implementation and results.
8	Technical Video based learning related to the analog and electronics	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
9	Online Certification Courses (NPTEL / SWAYAM / Coursera / edX) In analog electronics	Complete one MOOC (Massive Open Online Course) from NPTEL/SWAYAM relevant to ADE-Electrical Engineering.	Certificate + a 1-page summary or review presentation of the course. Certificate of the course
10	Real world case studies based learning in analog electronics.	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
11	Discussion on research paper based on analog electronics	5 research paper = 20 h	Summarize research paper and evaluation critical parameters
12	Poster/chart/power point preparation on analog electronics	Duration = 6 h	Based on poster/chart preparation and presentation skills
13	Working/non-working model on technical topics of analog electronics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
14	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/any	Duration = 15 h for industrial exposure Problem identification and	Based on evaluation of critical problems and solutions



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	other issue	tentative solution = 10 h Total = 20 h	
15	Group Discussion on emerging/trending technical topics based on analog electronics	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
16	Involvement in Student Chapter Activities (IEEE/ISTE/IEI)	Organizing student chapter activities/workshops (5h)+ Report /writing articles for the chapter newsletter(5h)	Based on short activity report and reflection
17	Industry Visit and Report Preparation	Attend an industry visit (e.g., to a substation, manufacturing unit, renewable energy plant) and prepare a detailed report.	Based on the report

Note:

- All the suggested activity should be related to the subject.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.
- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.
