Government of Karnataka

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Electronics and Communication	**Semester**	III
Course Code	20EC31P	**Type of Course**	Programme Core
Course Name	Analog Electronics	**Contact Hours**	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	**Credits**	6
CIE Marks	60	**SEE Marks**	40

1. Rationale

Analog electronics is a branch of electronics that deals with a continuously variable signal. It is widely used in radio and audio equipment along with other applications where signals are derived from analog sensors before being converted into digital signals for subsequent storage and processing. Analog Electronics offers a very elegant design with many components and would effectively act as an impetus to the digital world.

2. Course Outcomes/Skill Sets: On successful completion of the course, the students will be able to:

CO-01	Identify the components in a given analog electronic circuit and list their characteristics and uses.
CO-02	Study the given analog circuit and using the data sheets/specification sheets, list alternative electronic components for the given circuit.
CO-03	Construct an analog electronic circuit for a given application and demonstrate the working of that circuit either in Real or Simulated environment.
CO-04	Test a given circuit for a desired result/outcome, identify the problem and troubleshoot to obtain the desired result/outcome.

3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1,3,4	1,3, 4,6, 7	Power Supplies 1.Need, Types – Unregulated, Regulated – Linear, Switched, Battery, Selection Criteria of different power supplies 2. RPS & UPS – Online & Offline – Block Diagram and its working principle 3. SMPS – Block diagram and its working principle	Refer Table 1	1. Build 5V/12V Regulated Power Supply. 2a) Identify the components in a SMPS. 2b) Identify front panel control & indicators of UPS
2	1,3,4	1,3, 4,6, 7	Wave Shaping Circuits. 1. RC Integrator & RC Differentiator. 2. Clippers - Series, Shunt & Biased.	Refer Table 1	1. Generate the following waveforms from sinusoidal waveform. a. Trapezoidal waveform.

			3. Clampers – Positive Voltage & Negative Voltage, Voltage Multipliers – doubler, Tripler.		b. Positive Cycle. 2. Construct and verify voltage doubler and tripler circuit to multiply the input voltage.
3	1,2,3,4	1,3, 4,6, 7	Special Purpose Devices. 1. Features & Applications of Tunnel Diode, Varactor Diode. 2.Features & Applications of Gunn diode & PIN diode, Solar cell 3. Features & Applications of Schottky diode & UJT.	Refer Table 1	1. Identify & test all special purpose diodes and interpret their data sheets. 2. Simulate/Analyse Schottky diode/PIN diode/Gunn Diode/Varactor Diode application circuits.
4	1,2,3,4	2,3, 4,6, 7	Transistor Amplifiers. 1. Introduction, DC load line, Operating point, Need for biasing, Stabilization, stability factor. 2. Types of biasing-voltage divider bias for BJT. 3. Classification of Amplifiers-based on use, frequency, coupling methods & mode of operations (advantages, disadvantages)	Refer Table 1	1a. Demonstrate Numbering System of Semiconductor Devices. 1b. Identify Transistors in different packages and interpret their datasheets. 2a.Construct/Simulate a AND/OR Gate using transistors 2b. Design and construct voltage divider biasing circuit to fix an operating point and test the voltages
5	3,4	1,3, 4,6	1. Common Emitter Transistor Amplifier-Working, Voltage gain, phase reversal. 2. RC Coupled transistor amplifier-frequency response. 3. Power amplifiers- classification, principle & performance criteria of power amplifiers.	Refer Table 1	1.Construct voltage divider biased single-stage RC coupled CE amplifier and plot frequency response 2. Simulate the RC coupled amplifier using BJT. Verify the same using FET.
6	3,4	1,2, 5,6, 7	1. Working of Class A–Series-fed amplifier and transformer-coupled amplifier. Expression for output power and maximum power efficiency 2.Class B- Push pull Amplifier and complementary-symmetry push-pull amplifier. Expression for output power and maximum power efficiency. 3. Working of Class AB and Class C amplifiers. Stages of practical power amplifier, Concept and expression for voltage gain of multistage amplifiers.	Refer Table 1	1. Demonstrate and document the working of a power amplifier using video or simulator. 2. Construct and Demonstrate/Simulate the working of push pull amplifier. Verify the same using FET.

7	1,2,3	1,4, 6	1. Op-amp: Block diagram, Symbol, Basic differential amplifier- Working principle. 2. Modes of operation-Single ended, Common mode & Differential mode, Ideal and practical characteristics. 3.Op-amp parameters: Input offset voltage, input offset current, power supply rejection ratio, CMRR, Input and output impedance, gain, gain-bandwidth product, slew-rate	Refer Table 1	1. Identify Op-amp IC, its pins and Interpret its data sheet. 2. Conduct an experiment to find the practical characteristics of Op-amp and compare them with ideal characteristics.
8	3,4	1,4, 6	1. Open-loop configuration: Comparator-inverting, non-inverting, applications, disadvantages. 2. Closed-loop configuration: virtual ground, applications - inverting, non-inverting amplifier. 3. Voltage follower, summing & difference amplifiers.	Refer Table 1	1. Construct and test an op-amp circuit to obtain Inverting & Non inverting output. 2. Construct a circuit to obtain the Sum/Difference of all input voltages.
9	3,4	1,3, 4,6	1. Construct and verify Op-amp as Differentiator, Integrator. 2. Op-amp as Schmitt trigger and precision rectifier, Gain of Multistage Op-Amp Circuits. 3. Sinusoidal Oscillators, Types of Oscillations, LC Tank circuit and stability.	Refer Table 1	1. Construct a circuit to obtain triangular wave and spike from square wave. 2. Build an op-amp circuit to generate clock pulses and verify its working.
10	3,4	1,3, 4,6	1. Concept of feedback and types, Barkhausen criteria. 2. Types of Oscillators, Working of Hartley oscillator using BJT/Op-amp and its applications. 3. Working of Colpitts and crystal oscillator using BJT/Op-amp and their applications	Refer Table 1	1. Construct/Simulate Hartley oscillator using BJT. Verify the same using op-amp. 2. Construct, test and Troubleshoot Colpitts oscillator using BJT/op-amp.
11	3,4	1,3, 4,6	1. Working of RC phase-shift and Wein-bridge oscillators using Op-amp and their applications. 2. Filters: Classification, Applications & Advantages of Active over Passive Filters. 3. Filter Terminology, frequency response of 1st order Butterworth LPF, HPF (No Derivation).	Refer Table 1	1. Design and implement /Simulate RC phase shift oscillator for generating a frequency of 1khz using BJT. Verify the same using op-amp. 2. Conduct an experiment to plot the frequency response of LPF & HPF.

12	3,4	1,3, 4,7	1. Frequency response of 1st order Butterworth BPF and Band Elimination Filter, BEF (No Derivation). 2. Instrumentation amplifier-Need for instrumentation amplifier, Working of instrumentation amplifier circuit. 3. Phase Locked Loop (PLL): voltage to frequency converter, PLL operation with mention of its applications	Refer Table 1	1. Build an Instrumentation Amplifier Circuit to detect and Amplify Analog/Bio-Potential Signals (using simulator or video to be displayed) 2. Verify the working of PLL using a simulator.
13	1,3,4	1,3, 4	1. IC 555 Timer: Internal diagram, Pin Configuration. Interpret Datasheets. 2. IC 555 timer as Astable multivibrator. 3. IC 555 timer as monostable multivibrator.	Refer Table 1	1. Verify the working of IC 555 timer as astable multivibrator. 2. Verify the working of IC 555 timer as monostable multivibrator.
Total in hours			**39**	**13**	**52**

Note: 1) In Practice sessions Video demonstration should be followed by MCQs/Quiz/Subjective questions and the evaluation has to be documented.

2) In Practice sessions, all discrete circuits should be simulated using suitable software before its construction and verification.

TABLE 1: Suggested activities for tutorials

The list is shared as an example and not inclusive of all possible activities of the course.

The list of activities for one week can be shared among teams in a batch of students.

Week. No.	Suggested activities for tutorials
01	1. Gather knowledge and give a presentation on the type of power supply used in mobile charger, desktop computer and laptop with its specifications and Justify. 2. Build a Notch Filter to reject 50 Hz noise in power supplies and demonstrate it in the class. 3. Identify the type of UPS used in the lab, its specifications, analyze its load carrying capacity related to its power factor and prepare a report on it.
02	1. Design and build a circuit that can store maximum voltage of the input signal (Peak Detector) and demonstrate it in the class. 2. Prepare a report on any one application of peak detector in daily life, also compare the nature of output of a rectifier and a peak detector. 3. Prepare a video of a circuit which increases the input voltage 4 times. (Quadrupler).

03	1. Give a presentation on the use of opto isolator to detect DC or control AC signals and data. 2. Demonstrate the use of PIN diode as a switch in domestic applications. 3. Build a power supply switching circuit using optocouplers.
04	1. Prepare a report on applications of each type of amplifier and present it. 2. Demonstrate any one real life application of an amplifier.
05	1. Prepare a report and explain a specific application of emitter follower in daily life. (Ex: as switching circuit, isolator circuit, voltage buffer, impedance matching circuit). 2. Prepare a presentation on comparison of power amplifiers.
06	1. Prepare a video/report on any one real life application of a power amplifier. 2. Build and demonstrate radio player amplifier circuit. 3. Give a presentation on low noise amplifiers.
07	1. Explain the criteria for selecting an op-amp for a given application. 2. Identify at least 5 electronic circuits using op-amp and present the details of its working.
08	1. Prepare a report on comparison of transistor amplifier and op-amp. 2. Demonstrate the operation of auto cut for manual stabilisers using 741 IC.
09	1. Explain how an op-amp can be used in applications such as A/D converters, wave shaping circuits etc. 2. Prepare a report on Schmitt trigger applications such as switch debouncing, noise removal etc.
10	1. Demonstrate the operation of a variable audio frequency oscillator using op-amp 741. 2. Explain the working of FM radio jammer.
11	1. Discuss the problems to design and analyse 1st order butterworth filters. 2. Demonstrate how LEDs can be made to blink on the beats of music.
12	1. Prepare a report on different applications of instrumentation amplifier 2. Explain the operation of Frequency Shift Keying (FSK) generator using PLL 565.

13	1. Study the latest technological changes in this course and present the impact of these changes on industry. 2. Demonstrate the use of IC 555 timer in traffic light controller. 3. List the real life applications of IC 555 timer and explain any one application.

LINKS FOR REFERENCE.

1. https://www.teamwavelength.com/power-supply-basics/
2. https://www.tutorialspoint.com/electronic_circuits/electronic_circuits_smps.htm
3. www.electronicshub.org
4. https://images.app.goo.gl/xb2JnuqBKyaLgwi6A (Tutorial 6)
5. https://youtu.be/mgoCeOCjiBI (Experiment 7)
6. https://www.circuitstoday.com/
7. https://elec-club-iitb.github.io/blog/2016/09/get-electrified-2/
8. https://bestengineeringprojects.com/frequency-shift-keying-fsk-generator-using-pll-565/
9. https://images.app.goo.gl/cbkCDCHJngANwiyF6
10. http://www.allaboutcircuits.com
11. http://www.allaboutcircuits.com/videos

E-WEBSITES FOR REFERENCE

1. Electronic Tutorials
2. Spark fun-Learning section
3. All about circuits
4. Electronics theory
5. Electronics Lab
6. Instructables

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill tests 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Activity through Rubrics	1-13		10	10
				Total CIE Marks	60
	Semester End Examination (Practice)		180	100	40
				Total Marks	**100**

5. Format for CIE (1, 2, 3) Written Test

Course Name		Test	I/II/III	Sem	III/IV
Course Code		Duration	80 Min	Marks	30

Note: Answer any one full question from each section. Each full question carries 10 marks.

Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks
I	1			
	2			
II	3			
	4			
III	5			
	6			

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.

5.(a)Format for CIE-(4,5) Skill Test -Practice.

SL. No.	COs	Particulars/Dimension	Marks
1	1,2	Identify and test the given Electronic components - 10 Marks Interpret datasheet of any one Electronic component -10 Marks	20
2	3	Test the working of electronic circuit using simulation.	20
3	3 ,4	Conduct an experiment on analog circuit a) Writing the circuit diagram, tabular column, formula - 10 Marks b) Build the circuit -10 Marks c) Test, troubleshoot and demonstrate working of the circuit - 10 Marks d) Result - 10 Marks	40
4	1,2,3, 4	PortFolio evaluation of Practice sessions through rubrics	20
		Total Marks	**100**

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
					Average Marks= (8+6+2+2)/4=4.5		**5**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. Reference:

Sl. No.	Description
1	1. Electronic Devices and Circuits, S. Salivahanan , N. Sereshkumar , McGraw Hill Education (India) Private Limited, ISBN - 9781259051357
2	Op-amps and linear integrated circuits, Ramakanth A. Gayakwad, ISBN- 9780132808682
3	Principles of Electronics, Rohit Mehta and V K Mehta, S. Chand and Company Publishing, ISBN-9788121924504
4	Electronic Devices and Circuits, David A. Bell, Oxford University Press, ISBN9780195693409
5	Fundamentals of Electrical and Electronics Engineering, B. L. Theraja, S. Chand and Company Publishing. REPRINT 2013, ISBN-8121926602.

8. SEE Scheme of Evaluation

SL. No.	COs	Particulars/Dimension	Marks
1	1.2	Identify and test the given Electronic components - 10 Marks Interpret datasheet of any one Electronic component -10 Marks	20
2	3	Test the working of electronic circuit using simulation.	20
3	3 ,4	Conduct an experiment on analog circuit a) Writing the circuit diagram, tabular column, formula - 10 Marks b) Build the circuit -10 Marks c) Test, troubleshoot and demonstrate working of the circuit - 10 Marks d) Result - 10 Marks	40
4	1,2,3, 4	Viva-Voce	20
		Total Marks	**100**

9. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	20
2	MATLAB /PSPICE/Electronic Workbench Software for simulation		
3	Regulated Power Supply (Single)	1A/2A 0-30V	10
4	Regulated Power Supply (Dual)	1A/2A 0-30V	10

5	DC Voltage supply	(+/-5v, +/-12V, +/-15V	10
6	Digital multimeters		10
7	Function/Signal generator		10
8	Dual trace oscilloscope	Upto 20-30MHz	10
9	Electronic consumables (Diode, Transistor(npn and pnp), Resistors, Inductors, Capacitors, Special purpose diodes,etc)		Consumables as required
10	Step down transformers	6-0-6v 12-0-12v	10 each
11	OP-amps	741 IC	20
12	IC 555		10
13	Single strand wire/ patch cards	Different lengths	
14	Probes		10
15	Breadboard/Analog trainer kit		10