Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bengaluru

Course Title	:**ANALOG AND DIGITAL LAB**	Course Code	: 15EE36P
Semester	: **III**	Course Group	: **Core**
Teaching Scheme (L:T:P)	: **0:2:4** (in Hours)	Credits	: **3 Credits**
Type of course	: **Tutorial + Practical**	Total Contact Hours	: **78**
CIE	: **25 Marks**	SEE	: **50 Marks**
Programme: ELECTRICAL AND ELECTRONICS Engg.			

Pre-requisites	: Basic knowledge of Applied science, Applied Mathematics, Elements of Electrical Engg. And Electrical Circuit theory.
Course Objectives	**:** To provide practical knowledge of Diodes, Transistors, and applications, OP-AMP, Timers, Logic gates, Adders, Flip flops, Counters, MUX, DeMUX, 7 segment display, and digital interfacing.

Course Outcomes:

On successful completion of the Course, the student will be able to:

1. Understand the working of semiconductor Diodes and Transistors.
2. Analyse Opto-electronic devices Opto-isolator.
3. Test the Rectifier, Amplifier, OP-AMP and Timer circuits.
4. Test the working of Logic gates, Adder, flip flop, Counters, MUX and DeMUX.
5. Analyse the working of 7 segment display with BCD input.
6. Evaluate the interfacing of Switch, LED, Relay and DC Motor to CMOS and TTL ICs.

List of Graded Experiments:

PART A- ANALOG ELECTRONICS

1. Construct a suitable circuit to obtain the forward bias characteristics of Diode.
2. Rig up and test the Zener diode as Voltage regulator.
3. Construct and test the NPN transistor to obtain input and output characteristics in CE mode.
4. Build and test the circuit of Transistor as a Switch.
5. Construct and test the phototransistor (opto-isolator) as a switch.
6. Construct an experiment for full wave bridge rectifier circuit with and without C filter and measure ripple factor.
7. Build and test Single stage RC coupled amplifier and obtain frequency response on Semi-log graph sheet.
8. Construct and demonstrate OP-AMP as a Comparator.
9. Construct an experiment to test 555 Timer as Monostable multivibrator.

PART B- DIGITAL ELECTRONICS

10. Construct a circuit to verify the truth tables of NOT, AND, OR, NOR and NAND gates.
11. Construct a circuit to verify the truth table of Full Adder using basic gates.
12. Construct a circuit to verify the truth table of JK Flip flop using IC 7476.
13. Construct a circuit to verify the truth table of 4:1 multiplexer using IC 74153 and 1:4 De-multiplexer using IC 74139.
14. Rig up and test the truth table of Decade Asynchronous Counter IC 7490.
15. Construct an experiment to display0-9 digits using standard Seven segment display with the help of decoder/ driver IC 7446/ or 7447.
16. Construct and test interfacing of suitable CMOS IC to Switch, LED, 6V Relayand 12 V DC Motor (from Reference Book no. 3).
17. Construct and test Interfacing of suitable TTL IC to Buzzer and Solenoid (from Reference Book no. 3).

Reference Books:

1. Electronics Laboratory Primer by S. Poornachandra and B. Sasikala, S. Chand Publishers and Co, 2010.
2. Laboratory Experiments and PSPICE Simulations in Analog Electronics by L.K.Maheshwari and M.M.S.Anand Publishers – PHI Learning Pvt. Ltd.
3. *Digital Electronics*: Principles and Applications by R. L. Tokheim, Tata McGraw-Hill Education, 2013

e-Resources:

1. http://jntuhome.com/wp-content/uploads/2011/11/JNTU-B.Tech-Digital-Electronics-Lab-Manual.pdf
2. *www.physics.ibu.edu.tr/dosyalar/elek.pdf*

Composition of Educational Components:

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom's taxonomy) such as:

Sl. No.	Educational Component	Weightage (%)
1	Remembering	20
2	Understanding	20
3	Application/ Analysis	60
Total		**100**

Mapping Course Outcomes with Program Outcomes:
(Course Outcome linkage to Cognitive Level)

Course Outcome		Experiment linked	PO Mapped	Cognitive Level	Lab Sessions
CO1	Understand the working of semiconductor Diodes and Transistors.	1, 2, 3, 4	2, 3, 8, 9, 10	R/U/A	12
CO2	AnalyseOpto-electronic devices Opto-isolator	5	2, 3, 8, 9, 10	U/A	3
CO3	Test the Rectifier, Amplifier, OP-AMP and Timer circuits.	6, 7, 8, 9	2, 3, 8, 9, 10	U/A	12
CO4	Test the working of Logic gates, Adder, flip flop, Counters, MUX and DeMUX.	10, 11, 12, 13	2, 3, 8, 9, 10	U/A	12
CO5	Analyse Counter circuit and working of 7 segment display with BCD input.	14, 15	2, 3, 8, 9, 10	U/A	6
CO6	Evaluate the interfacing of Switch, LED, Relay and DC Motor to CMOS and TTL ICs.	16, 17	2, 3, 8, 9, 10	U/A	6

U-Understanding; A-application/ Analysis; App-Application

Course-PO Attainment Matrix

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
Analog and Digital Lab	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**3**

LEVEL 3- HIGHLY ADDRESSED, LEVEL 2-MODERATELY ADDRESSED, LEVEL 1-LOW ADDRESSED.

METHOD IS TO RELATE THE LEVEL OF PO WITH THE NUMBER OF HOURS DEVOTED TO THE COS WHICH ADDRESS THE GIVEN PO.
IF ≥40% OF CLASSROOM SESSIONS ADDRESSING A PARTICULAR PO, IT IS CONSIDERED THAT PO IS ADDRESSED AT LEVEL 3
IF 25 TO 40% OF CLASSROOM SESSIONS ADDRESSING A PARTICULAR PO, IT IS CONSIDERED THAT PO IS ADDRESSED AT LEVEL 2
IF 5 TO 25% OF CLASSROOM SESSIONS ADDRESSING A PARTICULAR PO, IT IS CONSIDERED THAT PO IS ADDRESSED AT LEVEL 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

Course Delivery:

The laboratory Course will be delivered through Tutorial, laboratory interaction, group discussion, practical exercises, instructions, assignments and viva voice.

Tutorial - 1Hr:

Staff-in-charge will;

1. Explain the concept and working of experiment to be conducted.
2. Impart/ discuss required selection of ICs/ components/ devices/ meters /equipment / suitable accessories for the experiment to be conducted.
3. Ask students to draw the circuit diagram, tabular column and truth table if any.
4. Give clear instructions about safety precautions to be followed while conducting the experiment.

Conduction/ Execution- 2 Hr:

Student will rig up the circuit diagram and conduct experiment individually under the supervision of the staff-in-charge.

Course Assessment and Evaluation:

	What		To Whom	Frequency	Practical	Evidence Collected	Course Outcomes
Direct Assessment Method	CIE (Continuous Internal Evaluation)	I A Tests	Students	Two IA tests for Practical (Average marks of both the tests)	10	Blue Books	1 to 6
		Record Writing		Record Writing (Average of Marks allotted for each experiment.)	10	Lab Record	1 to 6
				Student Activity	05	3 pages Report	1 to 6
				TOTAL	**25**		
	SEE (Semester End Examination)	End Exam	Students	End of the Course	50	Answer Scripts	1 to 6
Indirect Assessment Method	Student Feedback on course		Students	Middle of The Course	Feed Back Forms		1 to 6
	End of Course Survey			End of The Course	Questionnaire		1 to 6

*CIE – Continuous Internal Evaluation *SEE – Semester End Examination

Note:

1. I.A. test shall be conducted as per SEE scheme of valuation. However obtained marks shall be reduced to 10 marks. Average marks of two tests shall be rounded off to the next higher digit.
2. Rubrics to be devised appropriately by the concerned faculty to assess Student activities.

Suggested Student Activity (any one to be submitted with 3 pages report):

1. Using CRO measure amplitude, frequency, and time period of a signal from function generator.
2. Visit nearby Electronics shop/ market or in your Lab and prepare a report of different IC available for Voltage Regulators.
3. Construct and test MOSFET as a Switch.
4. Construct and test Crystal Oscillator.
5. Construct and test OP-AMP as Differentiator.
6. Construct and test OP-AMP as Integrator.
7. Construct and test OP-AMP as Voltage follower.
8. Construct and test OP-AMP as Inverting Amplifier.
9. Construct and test Binary Counter.
10. Construct and test any one type of Shift register.
11. Prepare a report on TTL and CMOS IC with pin diagram for interfacing different ratings of DC Motors.

MODEL OF RUBRICS / CRITERIA FOR ASSESSING STUDENT ACTIVITY (Course Coordinator)

Dimension	Scale					Students score (Group of five students)				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary	1	2	3	4	5
1	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	3				
2	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2				
3	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	5				
4	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	4				
Note: Concerned faculty (Course coordinator) must devise appropriate rubrics/criteria for assessing Student activity for 5 marks **One activity on any one CO (course outcome) may be given to a group of FIVE students** **Grand Average/Total**						14/4 =3.5 ≈4				

Example only: MODEL OF RUBRICS / CRITERIA FOR ASSESSING STUDENT ACTIVITY-
Task given- Industrial visit and report writing

Dimension	Scale					Students score (Five students)				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary	1	2	3	4	5
1.Organisation	Has not included relevant info	Has included few relevant info	Has included some relevant info	Has included many relevant info	Has included all relevant info needed	3				
2. Fulfill team's roles & duties	Does not perform any duties assigned	Performs very little duties	Performs partial duties	Performs nearly all duties	Performs all duties of assigned team roles	2				
3.Conclusion	Poor	Less Effective	Partially effective	Summarises but not exact.	Most Effective	5				
4.Convensions	Frequent Error	More Error	Some Error	Occasional Error	No Error	4				
					Total marks	14/4=3.5 ≈4				

Scheme of Valuation for SEE (Semester End Examination):

Note: The SEE Question paper should be set in such a way that Questions in the Question paper should have equal nos. of Questions from Part A and Part B.

Sl. No.	Particulars	Marks
1.	Identification of different components/ devices/ ICs	05
2.	Circuit diagram and Procedure (For any One experiment)	10
3.	Conduction	20
4.	Results	05
5.	Viva-voce	10
Total		**50**

Model Question Bank:

Course Title: **ANALOG AND DIGITALLAB**	Course Code: 15EE36P

1. Construct a suitable circuit to obtain the forward bias characteristics of Diode.
2. Rig up and test the Zener diode as Voltage regulator.
3. Construct and test the NPN transistor to obtain input and output characteristics in CE mode.
4. Construct and test the NPN transistor to obtain the output characteristics in CE mode.
5. Construct and test the NPN transistor to obtain the output characteristics.
6. Rig up a circuit to obtain the Transistor output characteristics.
7. Construct and obtain the results of Transistor as a Switch.
8. Rig up a circuit to show the Transistor operation as a Switch.
9. Build and test the circuit of Transistor as a Switch.
10. Construct and test the phototransistor (opto-isolator) as a switch.
11. Construct an experiment for full wave bridge rectifier circuit with C filter and measure ripple factor.
12. Construct an experiment for full wave bridge rectifier circuit without C filter and measure ripple factor.
13. Construct an experiment for full wave bridge rectifier circuit and obtain input and output waveforms and the voltages.
14. Build and test Single stage RC coupled amplifier and obtain frequency response.
15. Build and test Single stage RC coupled amplifier and obtain frequency response on Semi-log graph sheet.
16. Construct and demonstrate OP AMP as a Comparator.
17. Construct and test OP AMP Comparator circuit.
18. Construct an experiment to test 555 Timer as Monostable multivibrator.
19. Rig up 555 Timer as Monostable multivibrator and test the same..

PART B- DIGITAL ELECTRONICS

20. Construct a circuit to verify the truth tables of NOT, AND, OR, NOR and NAND gates.
21. Rig up and verify the truth tables of NOT, AND, OR gates.
22. Construct an experiment to verify the truth tables of NOT, NOR and NAND gates.
23. Construct an experiment to verify the truth tables of AND, OR and NAND gates.
24. Construct a circuit to verify the truth table of Full Adder using basic gates.
25. Construct and verify the truth table of Full Adder.
26. Construct a circuit to verify the truth table of JK Flip flop.
27. Rig up and verify the truth table of JK Flip flop using IC 7476.
28. Construct a circuit to verify the truth table of 4:1 multiplexer using IC 74153.
29. Construct a circuit to verify the truth table of 1:4 De-multiplexer using IC 74139.
30. Rig up and verify the truth table of 4:1 multiplexer.
31. Rig up and verify the truth table of 1:4 De-Multiplexer.
32. Rig up and test the truth table of Decade Counter using IC 74290.
33. Construct an experiment to test the truth table of Decade Counter.
34. Construct an experiment to display 0-9 digits using standard Seven segment display with the help of decoder/ driver IC 7446/ or 7447.
35. Rig up an experiment to display 0-9 digits using standard Seven segment display with the help of decoder/ driver IC 7446/ or 7447.
36. Rig up an experiment to display 0-9 digits using standard Seven segment display.
37. Construct an experiment to display 0-9 digits using standard Seven segment display using IC 7446/ or 7447.
38. Construct an experiment to display 0-9 digits using standard Seven segment display with decode.
39. Construct and test CMOS interface to Switch and LED.
40. Construct and test CMOS interface to Relay and DC Motor.
41. Construct and test CMOS interface to LED and Relay.
42. .Construct and test Interfacing of TTL to Buzzer and Solenoid.

Analog and Digital Lab Equipments Requirement:

Students Intake : 60
Students per Batch : 20

Sl. No.	Name of Equipment and Specification	Quantity Required
1.	DC Regulated power supply (0-30V, 2A)	10
2.	DC Regulated Dual power supply (+/- 15V,2A)	06
3.	DC Regulated Dual power supply (+/- 5, 1A)	06
4.	Cathode Ray Oscilloscope- Dual trace, 25 MHz.	06
5.	Signal Generator / Function generator(5V P-P, 200mA)	06
6.	DC Voltmeter (0-1V)	10
7.	DC Voltmeter (0-10V)	10
8.	DC Voltmeter (0-30V)	10
9.	DC Ammeter (0 -100µA)	05
10.	DC Ammeter (0 -10mA)	10
11.	DC Ammeter (0 -100mA)	10
12.	Digital Multimeter- $3^1/_2$”	06
13.	Analog Multimeter	06
14.	Decade resistance box (4 Dial)	10
15.	Decade capacitor box (4 Dial)	10
16.	Digital Trainer kit	10 No.
17.	Digital IC Tester	06 No.