ANALOG AND DIGITAL ELECTRONICS **Course Code : 313342**

Programme Name/s : **Mechatronics**
Programme Code : **MK**
Semester : **Third**
Course Title : **ANALOG AND DIGITAL ELECTRONICS**
Course Code : **313342**

I. RATIONALE

This course aims to develop skills to test electronic circuits, that is vital for a diploma holder in mechatronics while working in an industry. After studying this course, it is expected that student will develop an insight to identify, build and troubleshoot analog and digital electronic circuits at a wider scale in mechatronics based systems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified outcome through various teaching learning experiences: • Test different electronic circuits for relevant system.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Build different electronic circuits using basic components and diodes.
- CO2 - Interpret working of transistor in electronic circuits.
- CO3 - Use logic gates and Boolean Logic for building digital circuits.
- CO4 - Use combinational and sequential logic circuits for different applications.
- CO5 - Use data converters in electronic systems.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313342	ANALOG AND DIGITAL ELECTRONICS	ADE	DSC	4	-	4	-	8	4	3	30	70	100	40	25	10	25#	10	-	-	150

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Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Draw symbols of different semiconductor diodes. TLO 1.2 Explain V-I characteristic of PN junction diode. TLO 1.3 Explain characteristics of zener diode. TLO 1.4 Compare PN junction diode with zener diode. TLO 1.5 Describe working of rectifiers. TLO 1.6 Compare different parameters of rectifiers. TLO 1.7 Illustrate the working principle of filters. TLO 1.8 Explain zener diode as voltage regulator. TLO 1.9 Draw block diagram of DC regulated power supply. TLO 1.10 Build positive/ negative power supply using IC 7805/7905.	**Unit - I Semiconductor Diodes and Applications** 1.1 Symbol, construction and working principle of PN junction diode, zener diode, light emitting diode (LED), photo diode 1.2 Forward and reverse bias. VI characteristics of PN junction diode and zener diode 1.3 Types of rectifiers: Half wave, full wave, bridge rectifier, working principle, circuit diagram, Input and Output voltage waveform 1.4 Performance parameters of rectifier: PIV, ripple factor and efficiency 1.5 Need for filters: circuit diagram and working of L, C, and CLC filter 1.6 Zener diode working as voltage regulator 1.7 Working principle, block diagram of regulated power supply, IC 78XX and IC 79XX, complete DC power supply circuit	Lecture Using Chalk-Board Presentations Demonstration

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Classify unipolar and bipolar devices. TLO 2.2 Describe working of transistor. TLO 2.3 Explain output characteristics of transistor. TLO 2.4 Determine the current gain of transistor. TLO 2.5 Explain working of transistor as switch TLO 2.6 Explain transistor as an amplifier. TLO 2.7 Draw the symbol of N channel JFET and P channel JFET. TLO 2.8 Explain working principle of N channel JFET.	**Unit - II Bipolar Junction Transistor and Applications** 2.1 Unipolar and bipolar devices 2.2 Types, symbol of BJT, construction and working principle of NPN transistor 2.3 Configurations of transistor CE, CB and CC 2.4 Transistor parameters: alpha beta, input and output resistance, relation between alpha and beta 2.5 Input and output characteristics of CE configuration, saturation active and cut off regions in output characteristics 2.6 Transistor as a switch 2.7 Single stage RC coupled amplifier, circuit diagram function of each component 2.8 JFET symbol, types, construction and working principle	Lecture Using Chalk-Board Presentations Demonstration
3	TLO 3.1 Convert the given number into specified number system. TLO 3.2 Perform binary addition and multiplication. TLO 3.3 Perform subtraction using one’s and two’s compliment. TLO 3.4 Perform addition of decimal numbers using BCD code. TLO 3.5 Sketch symbols and truth tables of different logic gates. TLO 3.6 State different Boolean Laws. TLO 3.7 Prove De-Morgan’s theorems.	**Unit - III Number Systems and Logic Gates** 3.1 Number system: base or radix of number system, binary, octal, decimal and hexadecimal number system 3.2 Binary addition and multiplication 3.3 Subtraction using 1's compliment and 2's compliment 3.4 Logic gates: Symbol, logic expression and Truth table of basic gates (AND, OR, NOT), universal gates (NAND and NOR) and derived gates (EX-OR, EX-NOR) 3.5 Boolean algebra: Laws of Boolean algebra, De-Morgan's theorems	Lecture Using Chalk-Board Presentations Demonstration

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Implement adder/subtractor using logic gates. TLO 4.2 Explain working of multiplexer and demultiplexer using truth table. TLO 4.3 Draw the symbol and truth table of buffer. TLO 4.4 Draw RS Latch using NAND and NOR gate. TLO 4.5 Explain working of different flip-flops. TLO 4.6 Explain working of counter. TLO 4.7 Explain working of shift register.	**Unit - IV Combinational and Sequential Circuits** 4.1 Arithmetic circuits: Half and full Adder, half and full subtractor 4.2 Multiplexers and demultiplexers: block diagram working, truth table and applications of multiplexers and demultiplexers 4.3 Buffer: Tristate logic, symbol, truth table, unidirectional and bidirectional buffer 4.4 Basic memory cell: RS Latch using NAND and NOR gate 4.5 Block schematic and truth table of SR, JK, T, and D Flip Flop 4.6 Counters: Synchronous and asynchronous 3-bit 4.7 Shift resisters: Types, SISO- right and left shift registers	Lecture Using Chalk-Board Presentations Demonstration
5	TLO 5.1 Classify data convertors. TLO 5.2 Explain working principle of ADC/DAC. TLO 5.3 Draw pin diagram of ICs 0808/0809. TLO 5.4 Write broad specifications of ICs 0808/0809.	**Unit - V Data Convertors** 5.1 Data converters: Types, working of weighted resister and R-2R ladder circuit 5.2 DAC IC 0808 5.3 ADC: Block diagram, types and working of dual slope ADC, SAR ADC 5.4 ADC IC 0809	Lecture Using Chalk-Board Presentations Demonstration

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify type of given diode. LLO 1.2 Identify terminals of given diode.	1	Identification of various types of diodes	2	CO1
LLO 2.1 Measure forward resistance of PN junction. LLO 2.2 Test the functionality of PN junction diode.	2	Testing of PN junction diode using multimeter	2	CO1
LLO 3.1 Connect the circuit to plot VI characteristics of PN junction diode. LLO 3.2 Plot the VI characteristics of PN junction diode.	3	*Determination of VI characteristics of given PN junction diode	2	CO1
LLO 4.1 Connect the circuit to plot VI characteristics of zenor diode. LLO 4.2 Plot the VI characteristics of zener diode.	4	*Determination of VI characteristics of given zener diode	2	CO1
LLO 5.1 Develop the circuit of a half wave rectifier. LLO 5.2 Observe input-output waveforms and measure voltages.	5	Construction of half wave rectifier for observing input-output waveforms	2	CO1

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Develop the circuit of a bridge type full wave rectifier. LLO 6.2 Observe input-output waveforms and measure voltages.	6	*Construction of bridge type full wave rectifier for observing input-output waveforms	2	CO1
LLO 7.1 Make circuit connections to determine the performance of zener diode as voltage regulator. LLO 7.2 Measure output voltage for change in input voltage and load current.	7	*Testing performance of given zener diode as voltage regulator	2	CO1
LLO 8.1 Make connection as per circuit diagram and measure output voltage for voltage regulator IC 7805. LLO 8.2 Make connection as per circuit diagram and measure output voltage for voltage regulator IC 7905.	8	Testing performance of regulated power supply IC 7805 and IC 7905	2	CO1
LLO 9.1 Identify terminals of NPN transistor. LLO 9.2 Identify terminals of PNP transistor.	9	Identification of NPN and PNP transistor using multimeter	2	CO2
LLO 10.1 Make circuit connections to plot input/output characteristics of transistor in CE mode. LLO 10.2 Measure voltages and current to plot input/output characteristics of transistor.	10	*Part I: Determination of input characteristics of NPN transistor in CE mode *Part II: Determination of output characteristics of NPN transistor in CE mode	4	CO2
LLO 11.1 Make connections as per circuit diagram to determine the performance of transistor as a switch. LLO 11.2 Verify transistor as ON and OFF switch.	11	*Testing performance of transistor as a switch	2	CO2
LLO 12.1 Make connections as per circuit diagram to determine the gain and bandwidth of single stage RC coupled amplifier. LLO 12.2 Calculate gain and bandwidth of transistor.	12	*Determination of gain and bandwidth of single stage RC coupled amplifier	2	CO2
LLO 13.1 Test functionality of different ICs using digital IC tester.	13	Testing of different digital IC's using IC tester	2	CO3
LLO 14.1 Make circuit connections to verify truth table of of AND, OR, NOT, NAND and NOR logic gates. LLO LLO 14.2 Verify truth table of logic gates and measure the output voltage using multimeter for logic 0 and 1.	14	*Verification of truth table of AND, OR. NOT, NAND and NOR gates	2	CO3
LLO 15.1 Verify the truth table of EX-OR and EX-NOR gates. LLO 15.2 Measure the output voltage using multimeter for logic 0 and 1.	15	Verification of truth table of EX-OR and EX-NOR gates	2	CO3

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 16.1 Make connection to implement basic logic gates using NAND gate. LLO 16.2 Verify truth table of basic logic gates.	16	*Implemention of basic logic gates using NAND gate	2	CO3
LLO 17.1 Verify De-Morgan's theorem.	17	Verification of De-Morgan's theorem using logic gates	2	CO3
LLO 18.1 Make connections to develop half adder and half subtractor using logic gates. LLO 18.2 Verify truth table of Half Adder and half subtractor.	18	Implementation of half adder and half subtractor using logic gates	2	CO4
LLO 19.1 Construct full adder circuit. LLO 19.2 Verify truth table of full adder.	19	*Implementation of full adder using logic gates	2	CO4
LLO 20.1 Construct full subtractor circuit. LLO 20.2 Verify truth table of Full subtractor.	20	Implementation of full subtractor using logic gates	2	CO4
LLO 21.1 Identify the pins of IC 74151 and make connections as per circuit diagram. LLO 21.2 Verify the truth table of Multiplexer IC 74151.	21	*Implementiation of 8:1 multiplexer using IC 74151	2	CO4
LLO 22.1 Identify the pins of IC 74155/74154 and make connections as per circuit diagram. LLO 22.2 Verify the truth table of demultiplexer IC 74155/74154.	22	Verification of truth table of 1:8 demultiplexer using IC 74155/74154	2	CO4
LLO 23.1 Construct RS flip flop using NAND gate. LLO 23.2 Verify its truth table.	23	Implementation of RS flip flop using NAND gates	2	CO4
LLO 24.1 Verify truth table of D and T flip flop.	24	*Implementation of D and T flip flop using JK flip flop IC 7476	2	CO4
LLO 25.1 Test functionality of IC 7476 and make connections as per circuit diagram. LLO 25.2 Verify truth table of 3 bit counter.	25	*Implementation of 3 bit ripple/asynchronous counter using IC 7476/7473	2	CO4
LLO 26.1 Test functionality of IC 7474 and construct circuit diagram. LLO 26.2 Verify Serial in serial out right/ left shift operation .	26	Testing of 4 bit SISO shift register using IC 7474	2	CO4
LLO 27.1 Make connections of DAC circuit using R-2R resistive network. LLO 27.2 Measure analog voltage for corresponding digital input.	27	*Testing performance of R-2R resistive network for converting digital data input into analog output	2	CO5
LLO 28.1 Make connections of DAC circuit using weighted resister network. LLO 28.2 Measure analog voltage for corresponding digital input.	28	Testing of performance of weighted resister network for converting digital data input into analog output	2	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 29.1 Measure digital output for applied analog input voltage.	29	*Verification of operational features of ADC- IC 0809	2	CO5
LLO 30.1 Measure analog output voltage for corresponding digital input.	30	Verifcation of operational features of DAC- IC 0808	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Ammeter (0-25 mA), Voltmeter (0-5V, 0-10V DC)	1,2,3,4,5,6,7,8,9,10,11,12
2	Digital Multimeter: 3 1/2 Digit Display with R, V and I measurement and Diode, Transistor testing facility	1,2,3,4,5,6,7,8,9,10,11,12
3	Function Generator with TTL output: 20MHz	12
4	DC Regulated Fixed Power Supply: 5V Short Circuit protection display for voltage and current	13,14,15,16,17,18,19,20,21,22,23,24,25,26
5	Digital and Analog IC tester: To test wide range of ICs such as 74 series	13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30
6	Trainer kits for digital ICs: Trainer kit shall consist of Digital 1C's for logic gates, Flip-Flops, Shift Registers, counter along with toggle switches for inputs and bi-color LED at outputs and built in power supply	14,15,16,17,18,19,20,21,22,23,24,25,26
7	Dual Power Supply: +/- 15V	27,28,29,30
8	DC Regulated Power Supply: Variable DC Voltage 0-30V, 2A. Short Circuit protection display for voltage and current	3,4,7,8,9,10,11
9	Cathode ray Oscilloscope (CRO): 0-20 MHz Dual Trace, Dual Beam with Component Tester	5,6,12
10	Trainer kits/bread board, Logic IC's (7400, 7402, 7404, 7408, 7432, 7486, 74266, 7474, 7476, 74151, 741, 74155, 7805. 790 5) Electronic components (Rectifier Diode, LED, Zener Diode, Transistor, Resistors, Capacitors) for performing Practicals	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks

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Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Semiconductor Diodes and Applications	CO1	14	4	4	8	16
2	II	Bipolar Junction Transistor and Applications	CO2	14	2	6	8	16
3	III	Number Systems and Logic Gates	CO3	12	4	4	4	12
4	IV	Combinational and Sequential Circuits	CO4	14	2	6	8	16
5	V	Data Convertors	CO5	6	2	4	4	10
Grand Total				**60**	**14**	**24**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests of 30 marks and average of two unit tests.

For laboratory learning 25 marks.
Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- End semester assessment of 25 marks for laboratory learning.

End semester assessment of 70 marks through offline mode of examination.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	1	-	1	2	-	2			
CO2	3	1	-	1	2	-	2			
CO3	3	1	-	1	1	-	2			
CO4	3	1	-	1	2	-	2			
CO5	3	1	-	1	2	-	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number

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Sr.No	Author	Title	Publisher with ISBN Number
1	Sedha R. S	A text book of Applied Electronics	S. Chand, New Delhi, 2013, ISBN: 9788121928038
2	Mehta, V. K. , Mehta Rohit	Principles of Electronics	S. Chand, New Delhi, 2014, ISBN: 9788121924504
3	Bell, Devid	Fundamentals of Electronics Devices and Circuits	Oxford University Press, International edition, USA, 2015, ISBN: 9780195425239
4	B.L.Thereja	Basic Electronics Solid State	S. Chand New Delhi, ISBN: 9788121925556
5	Jain, R. P.	Modern Digital Electronics	McGraw-Hill Publishing, New Delhi. 2011, ISBN:978007066 9116
6	Maini, Anil K.	Digital Electronics Principles and Integrated Circuits	Wiley India, Delhi, 2016, ISBN: 9788126514663
7	Leach, D. P. Malvino A. P., Saha G.	Digital Principles and Applications	McGraw-Hill Publishing, New Delhi.2014, ISBN: 9789339203405
8	Charles H.Roth Jr|Larry L. Kinney Raghunandan G.H.	Analog Digital Electronics	Cenege Learning India Pvt.Ltd., ISBN: 9789353502355

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.tutorialspoint.com/basic_electronics/index.htm	Basic Electronics Components
2	https://www.tutorialspoint.com/digital_circuits/index.htm	Digital circuits
3	https://www.electronics-tutorials	Analog and digital circuits
4	https://www.iitg.ac.in/cseweb/vlab/Digital-System-Lab/experiments.php	Digital electronics experiments
5	https://www.electronicshub.org/semiconductor-diodes	semiconductor-diodes
6	https://archive.nptel.ac.in/courses/108/105/108105132/	Digital electronics circuits
7	https://www.electronicshub.org/types-of-adc-circuit/	Analog to digital converter
8	https://www.circuitstoday.com/digital-to-analog-converters-da	Digital to analog converters
9	https://www.geeksforgeeks.org/shift-registers-in-digital-logic/	Shift registers

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. **Semester - 3, K Scheme**