Programme Name/s	**: Digital Electronics/ Electronics & Tele-communication Engg./ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics/ Medical Electronics**
Programme Code	**: DE/ EJ/ ET/ EX/ IE/ MU**
Semester	**: Second**
Course Title	**: ELECTRONIC MATERIALS & COMPONENTS**
Course Code	**: 312316**

I. RATIONALE

This course is intended to help the students of Diploma Engineering to get idea of various Electronic Materials and Components employed in electronic industries. It will make the students familiar with the suitability of various electronic materials and components for different applications. This course is intended to develop skills of testing components that will be needed for the project and setting up of many experiments in basic and applied technology courses.

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: Use of various Electronic Materials and Components for relevant electronic applications

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify the relevant material for the Electronic Applications.
- CO2 - Suggest relevant electronic component(s) for the given application.
- CO3 - Identify the Surface Mount Devices for specific applications.
- CO4 - Develop the PCB for the given application.
- CO5 - Use specific components for roof top Solar Energy 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	
312316	ELECTRONIC MATERIALS & COMPONENTS	EMC	DSC	3	-	2	1	6	3	1.5	30	70*#	100	40	25	10	-	-	25	10	150

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 Explain the effect of the given factor on the resistivity of electrical material. TLO 1.2 Describe the characteristics of the given semiconductor material. TLO 1.3 Describe the properties of the given Photo emissive material. TLO 1.4 Explain the phenomenon of dielectric material. TLO 1.5 Select the dielectric material for the given application. TLO 1.6 Classify the magnetic material on the basis of given magnetic properties.	**Unit - I Electronic Materials** 1.1 Factors affecting the resistivity of material like temperature, area of cross-section, length (or distance) of the element. 1.2 Semiconductor materials: Intrinsic, extrinsic, charge carriers, P type and N Type, applications 1.3 Photo emissive materials: Properties, applications 1.4 Dielectric Materials: Types, Properties, Effect of frequency on performance of dielectric materials 1.5 Magnetic Materials: Properties, classification: Permanent magnetic dipole, diamagnetism, paramagnetism, ferromagnetism. 1.6 Soldering materials: Alloys and fluxes.	Chalk-Board Video Demonstrations Hands-on
2	TLO 2.1 Describe the property of passive component for the given parameter. TLO 2.2 Classify the active components TLO 2.3 Suggest the relevant combination of materials for the LED of the given color TLO 2.4 Describe the given type of IC and its package. TLO 2.5 Differentiate between the given types of ICs. TLO 2.6 Identify the relevant micro devices for the given application/s	**Unit - II Electronic Components** 2.1 Passive Components: Concepts of Resistance, Capacitance , Inductance . Specifications, type and applications Voltage Dependent Resistor(VDR), Temperature Dependent Resistor(TDR), Light Dependent Resistor(LDR). 2.2 Electronic Materials and doping level for PN junction diode, Zener diode, LEDs, PNP and NPN transistor, 2.3 Construction, working principle and applications of OLED 2.4 Integrated Circuit: Introduction to Monolithic IC, thick & thin film IC, Hybrid IC, Linear IC, Digital IC and IC packages (SIP, TO5, Flat, DIP), Pin , Device Identification, Temperature ranges. 2.5 Types and applications of micro electronic components: Micro motors, Micro relay, Micro switches	Chalk-Board Hands-on Model Demonstration Video Demonstrations

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.
3	TLO 3.1 Explain SMT and SMD. TLO 3.2 Describe the steps involved in the assembly technique in the SMT. TLO 3.3 Differentiate between the given type of the soldering/desoldering in SMT. TLO 3.4 Identify the need of SMT with respect to its advantages. TLO 3.5 Classify the SMD packages with respect to the given type of components.	**Unit - III Surface Mount Devices** 3.1 Introduction to Surface Mount Technology(SMT) and Surface mount Devices (SMD). 3.2 Assembly and rework techniques: Contact and noncontact types of soldering and de-soldering 3.3 Advantages and Disadvantages of SMT 3.4 SMD packages : Two terminal package for passive and active components, Three or four terminal packages, five or six terminal packages, More than six terminal packages; Examples of each 3.5 Automatic component insertion technique	Chalk-Board Model Demonstration Video Demonstrations Hands-on
4	TLO 4.1 Describe the constructional features of the given type of PCB. TLO 4.2 Compare the constructional features of the given type of PCB. TLO 4.3 Identify the types of the PCB with respect to applications. TLO 4.4 Describe the given method of PCB printing. TLO 4.5 Describe Electronic Waste Management.	**Unit - IV Printed Circuit Board** 4.1 Introduction to PCB, Advantages, disadvantages of PCB, Types of PCB and applications 4.2 Constructional features of PCB 4.3 Flexible PCB, Multilayer PCB, plated through hole (PTH) 4.4 Screen printing, photo-printing methods 4.5 Soldering Techniques: Dip, wave.reflow 4.6 PCB testing 4.7 Need of Electronic waste management , E-Waste Recycling,	Chalk-Board Model Demonstration Video Demonstrations Hands-on
5	TLO 5.1 State the basic principle of Photovoltaic Cell for the given application TLO 5.2 Illustrate construction of solar panel. TLO 5.3 List the different types of solar energy storage system for the given specifications TLO 5.4 Explain use of battery bank for solar power system . TLO 5.5 Choose the suitable battery for a solar energy system.	**Unit - V Solar system components** 5.1 Photovoltaic materials ,properties and applications 5.2 Solar Cell: Working Principle and Construction 5.3 Materials used in a Solar Panel 5.4 Energy storage system used in solar panel, its ratings and selection factors 5.5 Terminologies used in energy storage system like capacity, power ratings, depth of discharge (DoD), round-trip efficiency, warranty and life span	Chalk-Board Model Demonstration Video Demonstrations

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 Determine resistivity for a given length of wire keeping area constant	1	Determination of resistivity	2	CO1
LLO 2.1 Use photo electric cell to study I-V characteristics .	2	*Determination of photoelectric cell characteristics	2	CO1
LLO 3.1 Plot the charging and discharging curve of two different capacitors each having different dielectric material	3	Charging and discharging curve of two different capacitors	2	CO1
LLO 4.1 Identify various active and passive components in the given circuit.	4	*Identification of various electronic components in the given circuit.	2	CO2
LLO 5.1 Test the performance of Light Dependent Resistor (LDR) as a dark sensor	5	*LDR as a Dark Sensor	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Plot reverse bias characteristic of Photo-diode for different intensity of incident light on it.	6	Reverse Bias Characteristic of Photo-Diode	2	CO2
LLO 7.1 Test the identified analog IC's, digital IC's.	7	Testing of different IC	2	CO2
LLO 8.1 Determine SMD component value (Resistor, Capacitor and Inductor) using their nomenclature.	8	*Determination of SMD component value	2	CO3
LLO 9.1 Soldering of Surface Mounted Devices (SMD).	9	Soldering of SMD	2	CO3
LLO 10.1 Identify given SMD according to package type.	10	*Identification of given SMD	2	CO3
LLO 11.1 Test any small electronic circuit/system assembled on general purpose PCB and test it.	11	*Test any small electronic circuit/system	2	CO4
LLO 12.1 Use of open source PCB design simulation software and tools like eagle, Kicad, PCB, Dip trace, DesignSparkPCB	12	*Use of open source PCB design simulation software and tools.	2	CO4
LLO 13.1 Identification of types of PCB.	13	Identify types of PCB.	2	CO4
LLO 14.1 Plot V-I Characteristics of the solar cell.	14	*Characteristics of the solar cell.	2	CO5
LLO 15.1 Use a Solar Panel (Small panel approx- 4.5 V output) to drive any small load	15	Use of Solar Panel) to drive any small load	2	CO5
LLO 16.1 Measure voltage and current by connecting three batteries first in series and then parallel each having rating of 6V,2A	16	Voltage and current measurement using series and parallel connection of batteries	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)

Micro project

- Record values of different parameters (Direction, tilt angle, distance between pedestal, connection of solar panel)during installation of a solar panel by watching animation video
- Collect resistors of different values and make a chart for the specification and application of the same.
- Collect different samples of conducting material and prepare chart of their applications.
- Collect capacitors of different values and make a chart for the specification and application of the same.
- Test half wave rectifier circuit assembled on bread board
- Collect samples of zero PCB , blank PCB and general-purpose PCB
- Describe the solar panel installation process for residential purpose

Industrial Visit

- Visit any electronic industry note all the industry policies , work schedules latest trends and technology used in the industry .
- Visit any electronic manufacturing process industry observe all the operations, workstations, plants, machines, assembly lines, and management of industry and meet experienced professionals,make industrial visit report.
- Visit any electronic manufacturing process industry,watch all the processes and make industrial visit report.
- Visit a place where the solar panel is installed and note all specification of installation

Assignment

- Compare single-sided and double-sided PCB on the basis of different base.
- Make a chart showing a comparative study of commonly used cables in the lab.
- Explain with flow diagram the IC fabrication process
- Compare simple and SMD resistors
- Compare simple and SMD capacitors
- Describe how solar panel is made using solar cells

Note :

-Note : A suggestive list of micro project , assignment and industrial visit is given here. Similar activities could be added by the course teacher . For this course 1 hr per week are allocated for SL (Self Learning) in learning scheme. By considering 15 hr self learning work course teacher has to allocate one or two task may be combination of assignments and / or micro projects and / or Industrial visit. Microproject is expected to complete as a group activity. Course teacher can assign specific learning or any other skill development task . According to task assign , course teacher can set rubrics for continuous (formative) type assessment. SLA marks shall be awarded as per continuous assessment record.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Voltmeter - 0-10V, Ammeter 0-1A, Battery 0-12V, metal wire-40cm,50cm,60cm,70cm,80cm,90cm or as available, Resistance Box: 4 decade ranges from 1 ohm to 1K,accuracy 0.1 % - 1 %	1
2	Variable power supply 0-12V,500mA Microammeter 0-100µA Voltmeter/Multimeter 0 to 10V Photoelectric cell setup	2
3	Resistor, Capacitor, Voltmeter/Multimeter, Ammeter/Multimeter, Power Supply, Stop watch, Switch	3
4	Different passive components like resistors, capacitors, inductors, potentiometer, preset. Different active components like pn junction diode, Zener diode, LED, Transistor, FET, UJT	4
5	LDR ,LED, 1K ohm Resistor ,50K ohm Resistor ,BC547– BJT ,9V battery ,Breadboard	5
6	Photo-diode, voltmeter (0-10volt), microammeter, variable DC source(0-20 volt),wires/leads, resistor	6
7	IC tester, TTL IC's, CMOS IC's	7
8	Different values of SMD resistor, SMD capacitor and SMD Inductor	8
9	Soldering iron with soldering station(use 15,18 W iron), 63/27 flux cord solder wire, surface mounted components, magnifying glass	9
10	SMD of different packages like transistor SOT23 pack, transistor SOT89 Pack, IC SO8 Pack, IC SO14 pack	10
11	General purpose PCB, soldering iron, flux, soldering material, electronic circuit/system components, wire	11
12	Any Open source PCB design simulation software like eagle, Kicad, PCB, Dip trace, DesignSparkPCB, PC installed with software	12
13	Samples of given or any other smaller size of : 3X2 inches Phenolic Single Sided Plain Copper Clad Board (PCB), 5x7 cm Double Sided Universal PCB Prototype Board, 5x7cm Single Side Prototype Board, Flexible PCB,	13
14	A solar panel, a voltmeter, a micro-ammeter, a variable resistor and a 100 W lamp.	14
15	Solar panel (output 4.5V) cell and any load that it can drive	15
16	Solar Cells Potentiometer Voltage Meter Current Meter	16

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
1	I	Electronic Materials	CO1	10	4	4	8	16
2	II	Electronic Components	CO2	12	6	4	8	18
3	III	Surface Mount Devices	CO3	7	4	4	4	12
4	IV	Printed Circuit Board	CO4	8	4	4	4	12

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
5	V	Solar system components	CO5	8	4	4	4	12
Grand Total				**45**	**22**	**20**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- For laboratory learning 25 marks
- Each practical will be assessed considering - - 60% weightage to process and - 40% weightage to product
- Two formative assessment t tests of MCQ type for 30 marks and average of two unit tests.

Summative Assessment (Assessment of Learning)

- End semester assessment of 25 marks for laboratory learning
- End semester assessment of 70 marks

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	2	1	1	-	-	1	2			
CO2	2	2	2	2	2	1	2			
CO3	2	2	2	2	1	1	2			
CO4	2	2	2	2	2	1	2			
CO5	2	2	2	2	2	1	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
1	Milton Kaufman , Arthur H. Seidman , Perry J Sheneman	Handbook for Electronics Engineering Technicians Hardcover	McGraw-Hill ,SBN-13 978-0070334083
2	Charles A. Harper	Electronic Assembly Fabrication: Chips, Circuit Boards, Packages, and Components (ELECTRONICS)	McGraw-Hill Professional ,SBN-13 978-0071378826
3	Rathore	Fundamentals Of Renewable Energy Sources	Himanshu Publications: eISBN no.9781003245643
4	Walter ,Bosshart	Printed Circuit Boards	Tata McGraw Hill ISBN-13 978-0074515495
5	Grover & Jamwal	Electronic Components and Materials	Dhanpat Rai & Sons, ISBN-13 5551234023845
6	Dhir S M	Electronic Components and Materials	Tata McGraw Hill ISBN: 9780074630822
7	Madhuri Joshi	Electronic Components and Materials	Shroff Publishers & Distributors private ltd. ISBN-13: 978-8173669002

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.electronics-tutorials.ws/resistor/res_1.html	Resistors
2	https://www.greenmatch.co.uk/blog/2014/12/how-are-solar-panels-made	Solar panels
3	https://www.britannica.com/technology/integrated-circuit/Fabricating-ICs	IC fabrication
4	https://resources.pcb.cadence.com/blog/2023-ic-fabrication-process-flow-chart	IC fabrication process
5	https://en.wikipedia.org/wiki/Electronic_component	Different electronic components
6	https://www.seeedstudio.com/blog/2017/12/28/difference-between-smt-and-smd/	SMT and SMD
7	https://www.literoflightusa.org/how-are-solar-panels-made/	Solar cell and solar panel
8	https://www.google.com/search?q=practicle+on+solar+cell+experiment&sca_esv=573057508&rlz=1C1YTUH_enI	Solar cell characteristics
9	https://www.google.com/search?q=installation+process+of+solar+panels+animation&sca_esv=573067372&rlz	Installation of solar panel
10	https://renewablelab.niu.edu/experiments/seriesParallelSolarCells	Solar cell in sries and parallel
11	https://www.geeksforgeeks.org/intrinsic-semiconductors-and-extrinsic-semiconductors/	Types of semiconductor
12	https://www.electronicsandyou.com/blog/category/soldering	Soldering methods
13	https://www.electronicsandyou.com/blog/electronic-components	For electronic Components,SMT,PCB
14	https://www.electroniclinic.com/types-of-integrated-circuits-classification-of-ics-by-structure/	For Integrated Cicuits
15	https://www.electronicsandyou.com/blog/types-of-pcb-different-types-of-printed-circuit-board-pcb.html	Types of PCB
16	https://www.electronics-notes.com/articles/electronic_components/fet-field-effect-transistor/what-is-a-fet-types-overview.php	Types of FET
17	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2963874/	E -waste management
18	https://www.ewaste1.com/how-are-electronics-recycled/	E -waste recycle