

**Programme Name/s** : Digital Electronics/ Electronics & Telecommunication Engg./ Electrical and Electronics Engineering/ Electronics & Communication Engg./ Electronics Engineering/ Industrial Electronics/ Medical Electronics

**Programme Code** : DE/ EJ/ EK/ 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										Total Marks
				Actual Contact Hrs./Week			SLH	NLH	Paper Duration		Theory				Based on LL & TL				Based on SL		
				CL	TL	LL					Practical			SLA							
											FA-TH	SA-TH	Total		FA-PR		SA-PR				
Max	Max	Max	Min	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	<p>TLO 1.1 Explain the effect of the given factor on the resistivity of electrical material.</p> <p>TLO 1.2 Describe the characteristics of the given semiconductor material.</p> <p>TLO 1.3 Describe the properties of the given Photo emissive material.</p> <p>TLO 1.4 Explain the phenomenon of dielectric material.</p> <p>TLO 1.5 Select the dielectric material for the given application.</p> <p>TLO 1.6 Classify the magnetic material on the basis of given magnetic properties.</p>	<h3>Unit - I Electronic Materials</h3> <p>1.1 Factors affecting the resistivity of material like temperature, area of cross-section, length (or distance) of the element.</p> <p>1.2 Semiconductor materials: Intrinsic, extrinsic, charge carriers, P type and N Type, applications</p> <p>1.3 Photo emissive materials: Properties, applications</p> <p>1.4 Dielectric Materials: Types, Properties, Effect of frequency on performance of dielectric materials</p> <p>1.5 Magnetic Materials: Properties, classification: Permanent magnetic dipole, diamagnetism, paramagnetism, ferromagnetism.</p> <p>1.6 Soldering materials: Alloys and fluxes.</p>	<p>Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Hands-on</p>

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	<p>TLO 2.1 Describe the property of passive component for the given parameter.</p> <p>TLO 2.2 Classify the active components</p> <p>TLO 2.3 Suggest the relevant combination of materials for the LED of the given color</p> <p>TLO 2.4 Describe the given type of IC and its package.</p> <p>TLO 2.5 Differentiate between the given types of ICs.</p> <p>TLO 2.6 Identify the relevant micro devices for the given application/s</p>	<p><b>Unit - II Electronic Components</b></p> <p>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).</p> <p>2.2 Electronic Materials and doping level for PN junction diode, Zener diode, LEDs, PNP and NPN transistor,</p> <p>2.3 Construction, working principle and applications of OLED</p> <p>2.4 Integrated Circuit: Introduction to Monolithic IC, thick &amp; thin film IC, Hybrid IC, Linear IC, Digital IC and IC packages (SIP, TO5, Flat, DIP), Pin, Device Identification, Temperature ranges.</p> <p>2.5 Types and applications of micro electronic components: Micro motors, Micro relay, Micro switches</p>	<p>Chalk-Board</p> <p>Hands-on</p> <p>Model Demonstration Video</p> <p>Demonstrations</p>
3	<p>TLO 3.1 Explain SMT and SMD.</p> <p>TLO 3.2 Describe the steps involved in the assembly technique in the SMT.</p> <p>TLO 3.3 Differentiate between the given type of the soldering/ desoldering in SMT.</p> <p>TLO 3.4 Identify the need of SMT with respect to its advantages.</p> <p>TLO 3.5 Classify the SMD packages with respect to the given type of components.</p>	<p><b>Unit - III Surface Mount Devices</b></p> <p>3.1 Introduction to Surface Mount Technology (SMT) and Surface mount Devices (SMD).</p> <p>3.2 Assembly and rework techniques: Contact and noncontact types of soldering and desoldering</p> <p>3.3 Advantages and Disadvantages of SMT</p> <p>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</p> <p>3.5 Automatic component insertion technique</p>	<p>Chalk-Board</p> <p>Model Demonstration Video</p> <p>Demonstrations</p> <p>Hands-on</p>
4	<p>TLO 4.1 Describe the constructional features of the given type of PCB.</p> <p>TLO 4.2 Compare the constructional features of the given type of PCB.</p> <p>TLO 4.3 Identify the types of the PCB with respect to applications.</p> <p>TLO 4.4 Describe the given method of PCB printing.</p> <p>TLO 4.5 Describe Electronic Waste Management.</p>	<p><b>Unit - IV Printed Circuit Board</b></p> <p>4.1 Introduction to PCB, Advantages, disadvantages of PCB, Types of PCB and applications</p> <p>4.2 Constructional features of PCB</p> <p>4.3 Flexible PCB, Multilayer PCB, plated through hole (PTH)</p> <p>4.4 Screen printing, photo-printing methods</p> <p>4.5 Soldering Techniques: Dip, wave, reflow</p> <p>4.6 PCB testing</p> <p>4.7 Need of Electronic waste management, E-Waste Recycling,</p>	<p>Chalk-Board</p> <p>Model Demonstration Video</p> <p>Demonstrations</p> <p>Hands-on</p>
5	<p>TLO 5.1 State the basic principle of Photovoltaic Cell for the given application</p> <p>TLO 5.2 Illustrate construction of solar panel.</p> <p>TLO 5.3 List the different types of solar energy storage system for the given specifications</p> <p>TLO 5.4 Explain use of battery bank for solar power system.</p> <p>TLO 5.5 Choose the suitable battery for a solar energy system.</p>	<p><b>Unit - V Solar system components</b></p> <p>5.1 Photovoltaic materials, properties and applications</p> <p>5.2 Solar Cell: Working Principle and Construction</p> <p>5.3 Materials used in a Solar Panel</p> <p>5.4 Energy storage system used in solar panel, its ratings and selection factors</p> <p>5.5 Terminologies used in energy storage system like capacity, power ratings, depth of discharge (DoD), round-trip efficiency, warranty and life span</p>	<p>Chalk-Board</p> <p>Model Demonstration Video</p> <p>Demonstrations</p>

## 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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
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
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 ICs, digital ICs.	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 A 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 :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

## 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	SMD of different packages like transistor SOT23 pack, transistor SOT89 Pack, IC SO8 Pack, IC SO14 pack	10
3	General purpose PCB, soldering iron, flux, soldering material, electronic circuit/system components, wire	11
4	Any Open source PCB design simulation software like eagle, Kicad, PCB, Dip trace, DesignSparkPCB, PC installed with software	12
5	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
6	A solar panel, a voltmeter, a micro-ammeter, a variable resistor and a 100 W lamp.	14
7	Solar panel (output 4.5V) cell and any load that it can drive	15
8	Solar Cells Potentiometer Voltage Meter Current Meter	16
9	Variable power supply 0-12V,500mA Microammeter 0-100 $\mu$ A Voltmeter/Multimeter 0 to 10V Photoelectric cell setup	2
10	Resistor, Capacitor, Voltmeter/Multimeter, Ammeter/Multimeter, Power Supply, Stop watch, Switch	3
11	Different passive components like resistors, capacitors, inductors, potentiometer, preset. Different active components like pn junction diode, Zener diode, LED, Transistor, FET, UJT	4
12	LDR ,LED, 1K ohm Resistor ,50K ohm Resistor ,BC547 $\mu$ € BJT ,9V battery ,Breadboard	5

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
13	Photo-diode, voltmeter (0-10volt), microammeter, variable DC source(0-20 volt),wires/leads, resistor	6
14	IC tester, TTL IC's, CMOS IC's	7
15	Different values of SMD resistor, SMD capacitor and SMD Inductor	8
16	Soldering iron with soldering station( use 15,18 W iron), 63/27 flux cord solder wire, surface mounted components, magnifying glass	9

## 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
5	V	Solar system components	CO5	8	4	4	4	12
<b>Grand Total</b>				<b>45</b>	<b>22</b>	<b>20</b>	<b>28</b>	<b>70</b>

## 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	Walter ,Bosshart	Printed Circuit Boards	Tata McGraw Hill ISBN-13 978-0074515495
4	Grover & Jamwal	Electronic Components and Materials	Dhanpat Rai & Sons, ISBN-13 5551234023845
5	Dhir S M	Electronic Components and Materials	Tata McGraw Hill ISBN: 9780074630822
6	Madhuri Joshi	Electronic Components and Materials	Shroff Publishers & Distributors private ltd. ISBN-13: 978-8173669002
7	Rathore	Fundamentals Of Renewable Energy Sources	Himanshu Publications: eISBN no.9781003245643

## XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	<a href="https://www.electronics-tutorials.ws/resistor/res_1.html">https://www.electronics-tutorials.ws/resistor/res_1.html</a>	Resistors
2	<a href="https://www.greenmatch.co.uk/blog/2014/12/how-are-solar-panels-made">https://www.greenmatch.co.uk/blog/2014/12/how-are-solar-panels-made</a>	Solar panels
3	<a href="https://www.britannica.com/technology/integrated-circuit/Fabricating-ICs">https://www.britannica.com/technology/integrated-circuit/Fabricating-ICs</a>	IC fabrication
4	<a href="https://resources.pcb.cadence.com/blog/2023-ic-fabrication-process-flow-chart">https://resources.pcb.cadence.com/blog/2023-ic-fabrication-process-flow-chart</a>	IC fabrication process
5	<a href="https://en.wikipedia.org/wiki/Electronic_component">https://en.wikipedia.org/wiki/Electronic_component</a>	Different electronic components
6	<a href="https://www.seeedstudio.com/blog/2017/12/28/difference-between-smt-and-smd/">https://www.seeedstudio.com/blog/2017/12/28/difference-between-smt-and-smd/</a>	SMT and SMD
7	<a href="https://www.literoflightusa.org/how-are-solar-panels-made/">https://www.literoflightusa.org/how-are-solar-panels-made/</a>	Solar cell and solar panel
8	<a href="https://www.google.com/search?q=practicle+on+solar+cell+experiment&amp;sca_esv=573057508&amp;rlz=1C1YTUH_enI">https://www.google.com/search?q=practicle+on+solar+cell+experiment&amp;sca_esv=573057508&amp;rlz=1C1YTUH_enI</a>	Solar cell characteristics
9	<a href="https://www.google.com/search?q=installation+process+of+solar+panels+animation&amp;sca_esv=573067372&amp;rlz">https://www.google.com/search?q=installation+process+of+solar+panels+animation&amp;sca_esv=573067372&amp;rlz</a>	Installation of solar panel
10	<a href="https://renewablelab.niu.edu/experiments/seriesParallelSolarCells">https://renewablelab.niu.edu/experiments/seriesParallelSolarCells</a>	Solar cell in series and parallel
11	<a href="https://www.geeksforgEEKS.org/intrinsic-semiconductors-and-extrinsic-semiconductors/">https://www.geeksforgEEKS.org/intrinsic-semiconductors-and-extrinsic-semiconductors/</a>	Types of semiconductor
12	<a href="https://www.electronicandyou.com/blog/category/soldering">https://www.electronicandyou.com/blog/category/soldering</a>	Soldering methods
13	<a href="https://www.electronicandyou.com/blog/electronic-components">https://www.electronicandyou.com/blog/electronic-components</a>	For electronic Components,SMT,PCB

Sr.No	Link / Portal	Description
14	<a href="https://www.electronicclinic.com/types-of-integrated-circuits-classification-of-ics-by-structure/">https://www.electronicclinic.com/types-of-integrated-circuits-classification-of-ics-by-structure/</a>	For Integrated Cicuits
15	<a href="https://www.electronicandyou.com/blog/types-of-pcb-different-types-of-printed-circuit-board-pcb.html">https://www.electronicandyou.com/blog/types-of-pcb-different-types-of-printed-circuit-board-pcb.html</a>	Types of PCB
16	<a href="https://www.electronics-notes.com/articles/electronic_components/fet-field-effect-transistor/what-is-a-fet-types-overview.php">https://www.electronics-notes.com/articles/electronic_components/fet-field-effect-transistor/what-is-a-fet-types-overview.php</a>	Types of FET
17	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2963874/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2963874/</a>	E -waste management
18	<a href="https://www.ewaste1.com/how-are-electronics-recycled/">https://www.ewaste1.com/how-are-electronics-recycled/</a>	E -waste recycle

**Note :**

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