**Program Name** : **Diploma in Electronics and Telecommunication Engineering and Diploma in Digital Electronics**

**Program Code** : **EJ/DE/ET/EN/EX**

**Semester** : **Second**

**Course Title** : **Electronic Engineering Materials**

**Course Code** : **22217**

## 1. RATIONALE

'Electronic Engineering Materials' is the basic course for the Electronics and Communication engineering and Digital Electronics engineering student. Material science have undergone radical changes, especially due to requirement of electronic component in variety of application area.This subject will enable the student to know and apply facts, concepts and working principles for the selecting material and components for various electronics engineering applications.

## 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Select electronic engineering materials for specified electronics application.**

## 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency.

a. Choose relevant metal on basis of conductivity property.
b. Interpret the properties of dielectric materials.
c. Select relevant magnetic materials for the specified electronics application.
d. Select relevant semiconductor device fabrication materials .
e. Select material for the relevant applications.

## 4. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme | | | Credit (L+T+P) | Examination Scheme | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | | | | Practical | | | | | |
| | | | | Paper Hrs. | ESE | | PA | | Total | | ESE | | PA | | Total | |
| L | T | P | | | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Min |
| 3 | - | - | 3 | 3 | 70 | 28 | 30* | 00 | 100 | 40 | -- | -- | -- | -- | -- | -- |

*(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA is for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the UOs required for the attainment of the COs.*

***Legends:** **L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment.*

## 5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)





This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

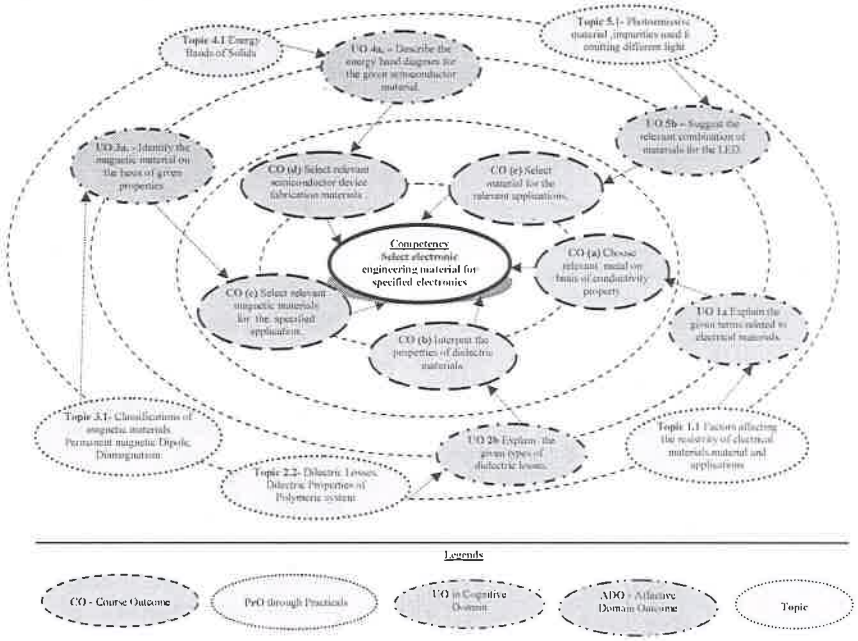


**Figure 1 - Course Map**

## 6. SUGGESTED PRACTICALS/ EXERCISES

- Not applicable –

## 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Not applicable –

## 8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics is to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency:

| Unit | Unit Outcomes(UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| **Unit – I Conductivity of Materials** | 1a. Explain the given terms related to electrical materials.<br>1b. Describe the effect on conductivity of metal on the basis of the given factor (s). | 1.1 Terms and factors affecting the resistvity of electrical materials<br>1.2 Electron mobility, energy level diagram of a materials<br>1.3 Emission of electrons from metals |

| Unit | Unit Outcomes(UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | 1c. Expain the given mode(s) of electron emission from metals.<br>1d. Explain the effect of change in temperature on the conductivity of the given metal. | modes of emission – therminoic emission , photo electric emission , field emission , secondary emission , concept, material and applications<br>1.4 Effect of temperature on conductivity of metals, superconductivity , electrial and thermal conductivity of metals<br>1.5 Thermoelectric effect concept , material and applications |
| **Unit-II Dielectric Materials** | 2a. Describe the effect on the capacitance on the given dielectric material on the basis of the given factor(s).<br>2b. Explain the given types of dielectric losses.<br>2c. Explain the concept of the given phenomenon of dilectric material..<br>2d. Select the dielectric material for the given application. | 2.1 Effect of dielectric on the behavior of capacitor , frequency dependence of electronic polarisability, frequency dependence of permittivity<br>2.2 Dilectric losses, dilectric properties of polymeric material<br>2.3 Insulating materials - breakdown in gaseous , liquid and solid delectric materials, requirements of good insulating materials<br>2.4 Dielectric materials –mica, porecilan , polythene , bakelite , polyvinylcarboide (PVC),rubber ,cotton and silk ,glass ,paper and Boards, wood, enamel covering, transformer oil, polymers properties and applications .<br>2.5 Ferroelectricity and piezoelectity concept , materials and applications |
| **Unit– III Magnetic Properties of Materials** | 3a. Identify the magnetic material on the basis of given magnetic properties.<br>3b. Describe the given Hysterisis loop identifying the material.<br>3c. Describe the effect on permeability of the material due to the given factor (s).<br>3d. Explain the concept anti ferromagnetism. | 3.1 Classifications of magnetic materials Permanent magnetic dipole, diamagnetism, paramagnetism, ferromagnetism ferromagntic domain<br>3.2 Magnetisation curve hysterisis loop magnetosteiction effect– application for ultrasonic generation, permeability and affecting factors<br>3.3 Magnetic material– iron and silicon iron alloy, nickel iron alloy,<br>3.4 Anti-ferromagnetism and ferrimagnetism |
| **Unit– IV Semi Conductor Materials** | 4a. Describe the energy band diagram for the given semiconductor material.<br>4b. Select the material for given type of impurity add in semiconductor.<br>4c. Explain the given effect of | 4.1 Energy bands of solids: conductors, semiconductors,nonconductors<br>4.2 Types of semiconductors, intrinsic material, impurity type and material for various impurities<br>4.3 Diffusion, hall effect,thermal and electrical conductivity of semi conductor |





| Unit | Unit Outcomes(UOs) (in cognitive domain) | Topics and Sub-topics |
|---|---|---|
| | semiconductor material and its application.<br>4d. Select the relevant material for the given semicoductor device fabrication with justification. | materials<br>4.4 Materials for fabrication of semiconductor devices – passive materials and process materials. substrate, metal, capacitance material. Junction coating , device pooting, Packaging |
| **Unit –V Micro-electronic components and special materials** | 5a. Explain with sketches the working of the given type of LASER.<br>5b. Suggest the relevant combination of materials for the LED of the given wavelength.<br>5c. Suggest the relevant material for the given type of antenna.<br>5d. Identify the relevant micro-device for the given application and the material of which it is made of. | 5.1 Photoemissive material, impurities used to emit different colours of light/ wavelengh; electroluminiscence and junction LASERS<br>5.2 Material for flexible and wearable antenas<br>5.3 Photovoltaic material<br>5.4 Materials used and application micro motors, micro relay and micro switches. |

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|---|---|---|---|---|---|---|
| | | | R Level | U Level | A Level | Total Marks |
| I | Conductivity of Materials | 10 | 06 | 06 | 06 | 18 |
| II | Dielectric Materials | 10 | 04 | 06 | 06 | 16 |
| III | Magnetic Properties of Materials | 10 | 04 | 06 | 06 | 16 |
| IV | Semi Conductor Materials | 10 | 04 | 04 | 04 | 12 |
| V | Microc electronic components and special materials | 08 | 02 | 02 | 04 | 08 |
| Total | | **48** | **20** | **24** | **26** | **70** |

***Legends**: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note:** This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Library / Internet survey of electrical /electronic material
b. Prepare power point presentation or animation for understanding different material behavior.
c. Access national digital Library for survey .

## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Use Flash/Animations to explain various theorems in circuit analysis
f. Guide student(s) in undertaking micro-projects

## 12. SUGGESTED MICRO-PROJECTS

***Only one micro-project*** is planned to be undertaken by a group of 3-4 student assigned to them in the beginning of the semester. They ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** **during the course.**

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare the chart of conducting materials
b. Prepare the chart of dielectric materials
c. Collect different samples of insulating material and prepare chart of their applications
d. Collect different samples of conducting material and prepare chart of their applications
e. Collect data for bifuel project erction
f. Make survey for PV cell as per efficiency and pricing.
g. Prepare chart for application of nanomateil
h. Demostrate effect of various modes of magnetism.

## 13. SUGGESTED LEARNING RESOURCES

| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| 1 | An Introduction to | C S Indulkar and S. | S Chand Publishing New Delhi |





| S. No. | Title of Book | Author | Publication |
|---|---|---|---|
| | Electrical Materials by | Thiruvengadam S | ISBN 9788121906661 |
| 2 | A course in Electrical engineering Materials | S.P. Seth and P.V. Gupta | Dhanpat Rai and Sons. |
| 3 | Material Science and Engg. | William D. Callister | WILLEY India 2/e Edition ISBN 9788126541607 |

## 14. SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=ooLJ_bGKmH
b. https://www.youtube.com/watch?v=emCqQdrSo3o
c. http://www.engineeringtoolbox.com/thermal-conductivity-metals-d_858.html