Maharashtra State Board of Technical Education (MSBTE)

I – Scheme

II– Semester Course Curriculum

Course Title: **Electronic Engineering Materials** (EJ, DE)

(Course Code: .....)

Diploma programme in which this course is offered	Semester in which offered
Electronics and Telecommunication Engineering Digital Electronics	Second

1. RATIONALE

'Electronic Engineering Materials' is a 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 materials for their magnetic properties.
d. Select relevant semiconductor device fabrication materials .
e. Select material for the relevant applications.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	-	-	3	70	30*	-	-	100

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA is for micro-project assessment to facilitate attainment of COs and the remaining 20 marks is for tests and assignments given by the teacher.

***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, Learning Outcomes i.e. LOs 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.

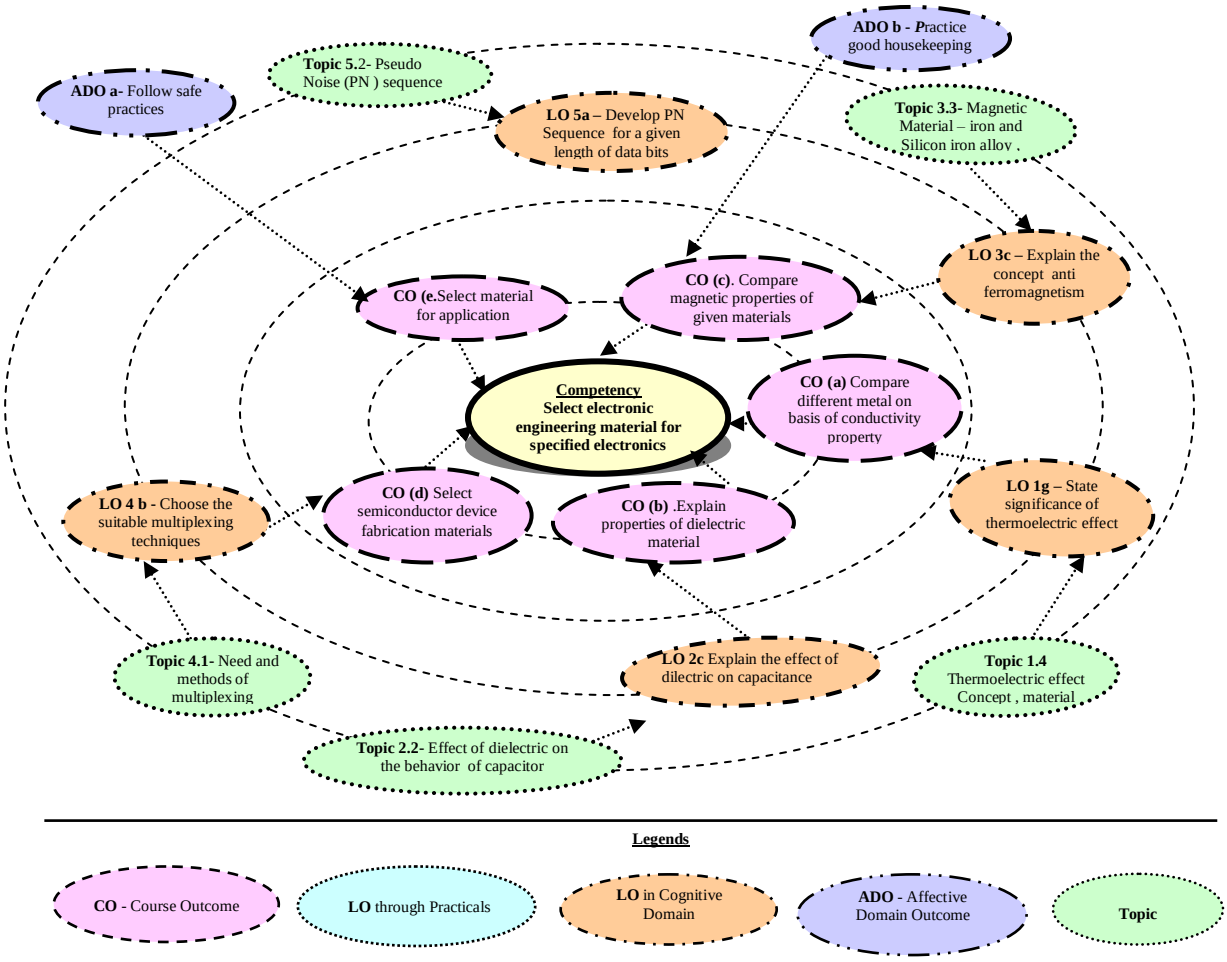

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

- Not applicable –

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Not applicable –

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Conductivity of Materials	1a. Explain the given terms related to electrical materials 1b. Describe the effect on	1.1 Factors affecting the resistvity of electrical materials.The electron gas model of a metal Motion of electron in electric field Electron mobility. Energt levels of a materials

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	conductivity of metal because of the given factor 1c. Expain the given mode(s) of emission of electron from metals	1.2 Emission of electrons from metals Modes of emission – Therminoic emission , Photo electric emission , Field emission , Secondary emission , concept, material and applications 1.3 Effect of temperature on conductivity of metals. Superconductivity . Electrial and thermal conductivity of metals 1.4 Thermoelectric effect Concept , material and applications
Unit-II Dielectric Materials	2a. Describe the effect on capacitance because of the given factor 2b. Explain the given types of losses 2c. Explain the concept of the given phenomenon.	2.1 Effect of dielectric on the behavior of capacitor . Frequency dependence of electronic polarisability. Frequency dependence of permittivity 2.2 Dilectric Losses Dilectric Properties of Polymeric system 2.3 Insulating Materials - Breakdown in Gaseous , liquid and Solid delectric materials, requirements of good insulating materials 2.4 Materials –properties and Application Mica, porecilan , Polythene , Bakelite , polyvinylcarboide (PVC),Rubber , Cotton and Silk ,Glass ,paper and Boards, Wood, Enamel covering, transformer oil, Polymers , 2.5 Ferroelectricity and Piezoelectity Concept and Applications
Unit– III Magnetic Properties of Materials	3a. Identify the given magnetic material on the basis of given properties. 3b. Describe the Hysterisis loop given in the given figure, 3c. Describe the effect on permeability due to the given factor. 3d. Explain the concept anti ferromagnetism	3.1 Classifications of magnetic materials Permanent magnetic Dipole, Diamagnetism, Paramagnetism, Ferromagnetism Ferromagntic Domain 3.2 Magnetisation Curve Hysterisis loop Magnetosteiction Effect– Application for ultrasonic generation, Permeability and affecting factors 3.3 Magnetic Material– iron and Silicon iron alloy, Nickel iron alloy, 3.4 Anti ferromagnetism and Ferrimagnetism
Unit– IV Semi Conductor Materials	4a. Describe the given energy band diagram for given material. 4b. Explain the given effect and its application 4c. Select the relevant material for the given semicoductor device fabrication process	4.1 Energy Bands of Solids 4.2 Types of Semiconductors Intrinsic Semiconductor Impurity type semiconductor 4.3 Diffusion , Hall effect ,Thermal and Electrical conductivity of semi conductor 4.4 Materials for fabrication of semiconductor devices – Passive materials and Process

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	with justification.	materials , substrate , metals ,Capacitance material, Junction coating , device pooting ,Packaging
Unit –V Microc electronic components and special Materials	5a. Explain with sketches the working of the given type of LASER. 5b. Select the material for given type of antenna with justification. 5c. Explain the working of the given Micro device with sketches	5.1 Photoemissive material Electroluminiscence and Junction LASERS 5.2 Photovoltaic material and PV cell 5.3 Nanomaterial 5.4 Material for flexible and wearable anteenas 5.5 Biofules 5.6 Micro motors, micro relay and micro switches

Note: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' 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	08	04	18
II	Dielectric Materials	10	06	06	04	16
III	Magnetic Properties of Materials	10	06	04	06	16
IV	Semi Conductor Materials	10	06	04	02	12
V	Microc electronic components and special Materials	08	06	02	-	08
Total		**48**	**30**	**24**	**16**	**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 LOs. 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 LOs/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 cognitive domain and affective domain LOs. 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 Electrical Materials by	C S Indulkar and S. Thiruvengadam S	S Chand Publishing New Delhi 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

15. COURSE CURRICULUM DEVELOPMENT COMMITTEE

MSBTE Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	AKOLE K.P. I/C HOD	Government Polytechnic Jalgaon	9421684899	Kp.akole@rediffmail.com
2	Dr. K. M. Bakwad, HOD	G.R.W.P. Latur	94234-40425, 96378-79421	bakwad_km@rediffmail.com
3	Mrs. Vidya S. Lunge HOD	V.E.S. Poly. Chembur	9323304026	vidya.lunge@ves .ac.in

NITTTR Bhopal Resource Person

S. No.	Name and Designation	Department	Contact No.	Email
1	Dr.Joshua Earnest, Professor	Electrical and Electronics Engineering	9406564239	jearnest@nitttrbpl.ac.in
2	Dr. Anjali Potnis, Assistant Professor	Electrical and Electronics Engineering	0755-2661600-02, (Ext. 368)	apotnis@nitttrbpl.ac.in