Department of General Science

College of Basic education

University of Salahaddin

Subject: Superconductor

Course Book – (Year 4)

Lecturer's name: Dr Abbas Hussein Rostam

Academic Year: 2023/2024

Course Book

1. Course name	**Second course Superconductor)**
2. Lecturer in charge	**Abbas Hussein Rostam**
3. Department/ College	**General Science / Basic education**
4. Contact	**e-mail: abbas.rostam@su.edu.krd** **Tel: (optional): 07504847714**
5. Time (in hours) per week	**Theory: 3** **Practical: No practical**
6. Office hours	**One hour during lessen and other time if necessary**
7. Course code	
8. Teacher's academic profile	**I am Abbas Hussein Rostam and I am born at 1963 in bngrd, I started primary school in bngrd, and then completed the secondary in the bngrd,**

	then I start and continuous in the study for the two stages (fourth and fifth) in the preparatory rania school , and then I am finished sixth stage in Sulaiman I am accepted in the University of Mosul collage of Science/ department of physic in the 1982, **I have been completed baccalaureate in the 1986 I have been completed Msc in the 2004 in Salahaddin University In the finally I have been completed Ph.D in the University of Mosul in the 2014, now I am studied in the General science / Basic education / in Salahaddin University**
9. Keywords	

10. Course overview

Obviously, people have been interested in the properties of superconductor since , superconductor have some properties more important compare with anther materials This course contain the historical of superconductors, for difference type , type one and type two superconductor, as well as the superconductor and normal conductor. The important characteristic of superconductor is 1-zero resistance 2- expel magnetic field in the internal superconductor (Meissner effect). These properties of superconductor appear effect on their application as mentioned in chapter four

The superconductor material has important application in the different fields such as all device in the modern technology

But we don't have laboratory in my collage for doing the practical experiments, however the practical study is very important in physics for understanding the students and also the theoretical time for study the students is three per week, this time suitable only for explain some important concept in superconductor physics.

11. Course objective:

This course aims to give the student an extended knowledge of the principles and techniques of solid state physics. Topics covered include the characteristic of superconductor, Critical magnetic field , critical temperature and critical current, and electrical properties of matter. The basic theory developed earlier in the program is developed further and its relevance illustrated in the context of important Applications in current day technology, industry, and research, transport mechanism. The course has a theoretical lecture component and also involves worked exercises to illustrate the material which the student must work through in order to fully understand this theoretical material.

To understand students to be able :

There are three significant critical parameters that keep up the superconducting state

1- :A- Critical temperature (Tc) B- Critical magnetic field (Hc) C- Critical current density (Jc)
2- : Magnetic Terminology
3- : definition of superconductor
4- Conduction Electron Transport
5- Fundamentally, superconductor is an element or a metallic alloy that possesses two distinguishing
6- properties
7- Meissner effect\
8- The Cooper Pairs B- penetration depth ,C- Coherence length D gI znberg landu parameters
9- type one and type two superconductor
10- *application of superconductors* in some sectors for example
A- Transportation Medicine , Industry, Communications , Research ,
Superconducting Generators , Maglev Systems, *Application in the Defense and space sectors.*

12. Student's obligation

The important role of students for interest the lecture and understanding must be attendance in all lecture, a notes through their lecture, and contribute question and their answer, for preparing for examination students as well must be doing all homework and reading all home works.

13. Forms of teaching

I am using the following method for teaching

1- Power point 2- white board for writing most important explanation solve problem

14. Assessment scheme

Breakdown of overall assessment and examination
For assessing the students by applying the following steps

1-	1 st Examination	16
2-	daily Activity	2
3-	2nd Examination	16
4-	daily Activity	2
5-	attendance of students	4
6-	**Final Exam**	60

15. Student learning outcome:

After successfully completing this course the students will study principle of superconductor that must be describe it will be :

A perfect superconductor is a material that exhibits two characteristic properties, namely zero electrical resistance and perfect diamagnetism, when it is cooled below temperature Tc, called the critical temperature. At higher temperatures it is a normal metal, and ordinarily is not a very good conductor. For example, lead, tantalum, and superconductors, while copper, silver, and gold, which are much better conductors, do not superconductor. In the normal state some super-conducting

metals are weakly diamagnetic and some are paramagnetic. Below Tc they exhibit perfect electrical
conductivity and also perfect or quite pronounced diamagnetism.
Explain all theoretical about development of superconductor such as BCS Theory, cooper Pair , Giznberg and landau theory
Normal electron and superelectrons, application of superconducting materials .

16. Course Reading List and References:

1- Key references:
2- Superconductivity (Charles P. Poole)
3- Superconductivity, Superuids and Condensates. (James F. Annett).
4- introduction to solid state physics (Charles kittel)
5- Elementary solid state physics principle and application (M.A Omer)
6- Solid state physics

- Useful references:

1- Superconductivity. K.H. Bennemann, J.B. Ketterson:
2- Superconductivity
Volume 1: Conventional and Unconventional
3- Superconductors
Volume 2: Novel Superconductors
4- MATERIAL SCINCE. (S.L. KAKANI AMIT KAKANI).
5- SUPERCONDUCTIVITY. J B KETERSON AND SB SONG.
6- Principle of Engineering physics . Md.N. Khan.S. Panigrahi

17. The	**Lecturer**
Chapter one *(1st , 2nd 3rd) Weeks* *1-1 :* introduction :History of Superconductor 1-1: Significant parameters of superconducting state 1-2: There are three significant critical parameters that keep up the superconducting state 11- 2---1: Critical temperature (Tc) 1-2-2: 2- Critical magnetic field (Hc) 1-2-3: 3- Critical current density (Jc) 1-3: Magnetic Terminology 1-4: definition of superconductor	Lecturer's ex: (2 hrs

1-5: Conduction Electron Transport

1-6: Fundamentally, superconductor is an element or a metallic alloy that possesses two distinguishing properties

Chapter Two Superconductor

(4th , 5th , 6th and 7th) Weeks

Experimental Survey

2-1: Meissner effect\

2-2: Characteristic phenomenological parameters

Fundamentals Parameters of the Superconductivity

2-2-1: A- The Cooper Pairs B- penetration depth ,C- Coherence length D gI znberg landu parameters

2-3: type one and type two superconductor

2-4: Isotope effect

2-5: Some problems

Chapter three

(8th , 9th 10th and 11th) Weeks

3-1: Normal and superconducting electrons

3-2 : comprising between superconducting and normal state

3-3: Microscopic theory of superconductor

3-4:BCS Theory

3-5:Two fluid model and AC fields

Chapter four application of superconductors

(12th , 13th, 14th and 15th) Weeks

4-1 : Overview of Applications

4-2: Current Commercial Applications

4-3: Emerging Applications

4-4: Electric Power

4-5: Transportation

4-6 : Medicine

4-7: Industry

4-8: Communications

4-9: Scientific Research

10-: Superconducting Generators

4-11: Maglev Systems

4-12: *Application in the Defense and space sectors*

18. Practical Topics (If there is any)	
Superconductor don’t have practical	

Kurdistan Regional Government Iraq **Module : Superconductor**

Ministry of Higher Education & Scientific Research **Stage : fourth**
Salahaddin University –Erbil **Round:-first**
College of Basic Education **Time : 2 hours**
Department : General Science

Exams: second semester

12-5-2024

Q1 A- Explain relation between resistivity and temperature (6+6+8) Marks

For superconductor.

B-Compare between penetrate depth a(t zero kelvin and critical temperature.

C-Draw the type 2 superconductor relation between magnetic fields and temperature

Q2 Answer only one branch (8+8) Marks

A- Explain Two fluid model of superconductor.

B--Explain microscopic theory of superconductivity (cooper pairing)

Q3: A-Write the main advantages of Maglev transportation systems. (6+6+6 Marks

B- Calculate the number of the super electron and normal electron at $T = \frac{1}{3} T_C$

C- The superconducting transition temperature of fixed material is 20 K, the initial

Magnetic field at 0 K is 400 mT Calculate the magnetic field at 10 K.

Q4 : Choose the correct answer (Only seven) . 14 M arks

1- At $0 < T < T_C$ of superconductor
($A - n_{nor}$ and n_s increase B- n_{nor} increase and n_s decrease C-n_{nor} decrease and n_s increase)

2- Electrons in cooper pairing is

(A – fermions in the same states B- Bosons in the same states C- Bosons in the difference states)

3- If $\lambda_0 = 2\lambda$ the number of super electron is equal

(A- 2 B- 4 C- 0.25) total electrons

4- Material In type two superconductor when
(A- $K < 0.7$ B- $K = 0$ C- $K > 0.7$)

5- Application of superconductor in communication digital circuit is used
(ADemonstrated with LTS B- Possible for LTS C- Demonstrated with HTS)

6- Superconductor is
(A- Paramagnetic B- Ferromagnetic C-Diamagnetic) material

7- Mobility in ionized scattering is due to
(A-Temperature and Impurity B- Temperature and lattice vibration
C- Temperature resistance) .

8- Material which have greatest conductivity is called
(A- Insulator B- conductor C-Superconductor)

9- Normal state is
(A- Perfect Meissner effect B- Meissner effect C-not Meissner effect).

Best wishes

- Lecture\ Instructor: Dr Abbas H Rostam

Signature Date: 12 /5/2024

21. Peer review پێداچوونەوەی هاوەڵ

This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.
(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject). .