Department of Physics

College of Science

University of Salahaddin

Subject: Electrical Circuit Analysis(II)

Course Book – (2nd Class)

Lecturer's name: Khidir Hamedamin Husain

Academic Year: 2023/2024

Course Book

1. Course name	**Electrical Circuit Analysis**
4. Lecturer in charge	**Khidir Hamedamin Husain**
3. Department/ College	**Physics / Science**
3. Contact	**e-mail: khdr.husen@su.edu.krd**
3. Time (in hours) per week	**Theory: 3** **Practical: 4**
4. Office hours	**3**
4. Course code	**SPh401**
7. Teacher's academic profile	My Academic studies starts with the acceptance in the B.Sc. program in 4004 as an undergraduate student in Physics department and extended as I finished the following education degrees **Education:** B.Sc, 4001 — Physics- College of Science M.Sc.4013 — Radiation Science **Academic titles attained:** Academic title: Assistant Lecturer — Date of attainment: 4/3/4013 I starts my Academic role as a staff member giving lectures in my specialization through theoretical and practical modules to the students in undergraduate stages, **Main Teaching Areas:** * Radiation Dosimetry * Electrical Measurements * Nuclear Physics Lab. * Laser Lab. * Electrical Measurements Lab.
1. Keywords	**Electrical Circuit, Circuit Analysis, Oscilloscope, AC and DC Circuits, Bridge Circuits, Semiconductors Diodes, Transient Circuit.**

10. Course overview:

The course will start with a brief description of, Bridges , AC Circuits , Transient behaviour Of DC Circuits , Circuit Theories (Kirchhoff's laws) and circuit Analysis . Semiconductors (P – N) Semiconductor Junctions (Diodes) Laws , Types of Diodes , Circuit Applications.

11. Course objective:

the course subject of the electrical Circuit Analysis has topics providing theoretical principles for circuits Analysis.

Instrument types and their basic theories, instrument converting, scale extension. theories of semiconductor (p – n) junctions (diodes), construction; characteristics and its practical circuit applications. Electrical instrumentation is a useful and important empirical subject has many wide applications in electrical engineering and electronic applications it is marketable force subject.

14. Student's obligation

The class attendance on time is the first obligation of the student. During the two courses three compulsory written exams will be done beside three or more pop quizzes inside the lectures. As well solving exercises and given problems is the student duties.

13. Forms of teaching

All the lecture outlines are prepared and will be a subject of open discussion inside the lectures. In the beginning of each lecture a brief summary of the previous lecture will be remembered and the headlines of the forward lecture is identified and determined. The materials given in the lecture is always accompanied by the illustrations and detail derivations with the aid of white board and available animations; beside this for every physical phenomenon there will be scientific and live discussion which assists the student to understand the subjects. The lectures will be given mainly in the English language. Throughout the lectures as well as at the end of each chapter there will be home work problems given to the students as a review and assessments.

13. Assessment scheme

The qualified assessment of the student level in general was based on the written examinations in class room. Maximum passing level is 100 marks, and minimum of 30 marks. 30 marks 0n first and second seasons examines and 40 marks on the final examine, their sum is the final marks. Some cases 10 marks for quizzes.

13. Student learning outcome:

The students who have succeed with good level of marks must have attained more about the course book. Then he will be marketable worker either in electrical engineering or electronic circuits

and instrumentations. circuit theories of diode and their applications will make him able to work as a good technician in electronics, Electrical engineering, connecting electricity circuits, and secondary school teacher of physics.

14. Course Reading List and References:

1- ***Electrical measurements and measuring instruments. By A.K. Sawhney 4004.***

2- ***E.W. Golding and E.C. Widdis. Electrical measurements. 1144.***

3- ***J. B. Gupta. Electrical measurements and measuring instruments .1144.***

4- ***Analysis of Electrical circuits and networks by: Jaydeep Chakravorty. 4001.***

5- ***Electrical engineering by: Nitin Saxena. 4001.***

6- ***Electrical measurements and instrumentation by: A.U. Bakshi, A.V. Bakshi 4013***

7- ***Electronic devices and circuit theory. By Robert L. Borylated 11th ed. 4011.***

8- ***Electronic Instrumentation and Measurements. By David Abell 4nd Edition 4003***

14. The Topics:	**Lecturer's name**
1. Semiconductor devices 1.1 Theories of Semiconductor (P – N) junction 1.4 Diode formation 1.3 Energy band diagram	ex: (3 hrs) weeks (1)
1.3 derivation of junction potential barrier and junction (I – V) equations 1.5 Studies of the P –N junction (diode) (I – V) characteristics curves	 ex: (3hrs) weeks (2)
1.4. Diode circuit applications 1.4.1 Rectifiers circuits 1.4.4 Clipping circuits	 ex: (3hrs) weeks (3)
1.4.3 Clamping circuits 1.4.3 Voltage doubling circuits	 ex: (3 hrs) weeks (4)
4. Alternating Circuits (AC) 4.1 Series single phase arc circuits analysis 4.1.1 R-R circuits showing phase analysis between voltage and current	ex: (6 hrs)

4.1.4 R-C circuits showing phase analysis between voltage and current 4.1.3 R-L circuits showing phase analysis between voltage and current	weeks (4 + 5)
4.4 Series RLC circuit 4.3 Parallel R - L, R- C, circuit phase angle between the currents and the voltage 4.3 Series and parallel arc resonance circuits 4.5 Power dissipation in a.m. circuits 4.6applications of AC in electrical engineering, networks transferring energy	ex: (6 hrs) weeks (6+7)
FirstExamination	ex: (2 hrs) weeks (8)
3. Bridge circuits and their applications 3.1 D.C. Wheatstone bridge 3.4 A.C. Wheatstone bridge 3.3 A.C. Maxwell bridge 3.3 Wine arc. bridge 3.4 Maxwell – Wine, arc bridge and others.	ex: (9 hrs) weeks (9 + 10+11)
4. Transient Circuits Analysis 4.1 Introduction 4.2 RL circuits 4.3 RC circuits 4.3 RLC circuits.	(6hrs) week (12+13)
Second Examination	ex: (2 hrs) weeks (14)
17. Practical Topics (If there is any)	
In this section the lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture	
11. Examinations: ***Q1.*** A 740 Ω resistor with an accuracy of $\pm 10\%$ carries a current of 10 mA. The current was measured by an analog ammeter on a 43-mA range with an accuracy	

of ±4% of full scale. Determine the accuracy in the Power in the resistor. (10marks)

$$P = I^2R$$
$$P = (10\text{ mA})^2 \times 820\ \Omega$$
$$= 82\text{ mW}$$

$$error\ in\ R = \pm 10\%$$

$$error\ in\ I = \pm 2\%\text{ of }25\text{ mA}$$
$$= \pm 0.5\text{ mA}$$
$$= \frac{\pm 0.5\text{ mA}}{10\text{ mA}} \times 100\%$$
$$= \pm 5\%$$

$$\%\ error\ in\ I^2 = 2(\pm 5\%)$$
$$= \pm 10\%$$

$$\%\ error\ in\ P = (\%\text{ error in } I^2) + (\%\text{ error in } R)$$
$$= \pm(10\% + 10\%)$$
$$= \pm 20\%$$

Q4. Design a multirange ammeter by using direct method to give the following ranges 10mA, 100mA, 1A, 10A, and 100A. If arsenal meter has internal resistance of 10Ω and full-scale current of 1mA. (10marks)

Sol:

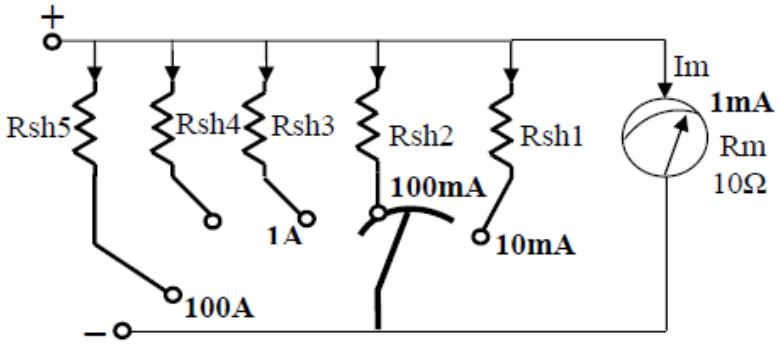
Rm=10Ω Im=1mA

$$\boxed{Rsh_{*} = \frac{\mathrm{Im}\,Rm}{Ir_{*} - \mathrm{Im}}}$$

$$Rsh1 = \frac{1\times10^{-3}\cdot10}{(10-1)\times10^{-3}} = 1.11\Omega \qquad Rsh2 = \frac{1\times10^{-3}\cdot10}{(100-10)\times10^{-3}} = 0.101\Omega$$

$$Rsh3 = \frac{1\times10^{-3}\cdot10}{1-10\times10^{-3}} = 0.0101\Omega \qquad Rsh4 = \frac{1\times10^{-3}\cdot10}{10-1\times10^{-3}} = 0.0011\Omega$$

$$Rsh5 = \frac{1\times10^{-3}\cdot10}{100-1\times10^{-3}} = 0.00011\Omega$$



Q3. An electrically deflected CRT has a final anode voltage of 4000 V and parallel deflecting plates 1.3 cm long and 3 mm apart. If the screen is 30 cm from the center of deflecting plates, find:
(10 marks)

(a) beam speed,
(b) the deflection sensitivity of the tube
(c) the deflection factor of the tube.

Solution Velocity of the beam

$$v_{ox} = \sqrt{2eE_a/m} = \sqrt{\frac{2\times 1.6\times 10^{-19}\times 2000}{9.1\times 10^{-31}}} = 26.5\times 10^{6}\ \text{m/s}$$

Deflection sensitivity,

$$S = \frac{Ll_d}{2dE_a} = \frac{0.5\times 1.5\times 10^{-2}}{2\times 5\times 10^{-3}\times 2000} = 0.375\ \text{mm/V}$$

$$\text{Deflection factor, } G = \frac{1}{S} = \frac{1}{0.375} = 2.66\ \text{V/mm}$$

Q3. The impedance of the basic a.c bridge are given as follows:
Z1= 100 ∠70° (inductive impedance) Z4 = 430Ω Z3 = 300 ∠ 30° (inductive impedance Z3 = unknown
(10 marks)

Sol:

$\boxed{Z_4 = \frac{Z_2 Z_3}{Z_1}}$ $Z_4 = \frac{250\times 400}{100} = 1k\Omega$ $\boxed{\theta_4 = \theta_2 + \theta_3 - \theta_1}$ $\theta_4 = 0 + 30 - 80 = -50^\circ$

$Z_4 = 1000\angle -50^\circ$ (capacitive impedance)

Example (2):

For the following bridge find Zx?

The balance equation $Z_1 Z_4 = Z_2 Z_3$

$Z_1 = R = 450\Omega$

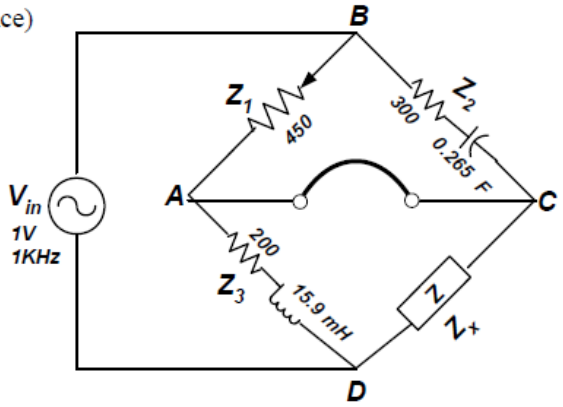
$Z_2 = R + \frac{1}{j\omega C} = R - \frac{j}{\omega C}$

$Z_2 = 300 - j600$

$Z_3 = R + j\omega L$

$Z_3 = 200 + j100$

$Z_4 = Z_x = unknown$



$Z_4 = \frac{Z_2 Z_3}{Z_1}$ $Z_4 = \frac{(300 - j600)(200 + j100)}{450} = 266.6 - j200$

$R = 266.6\Omega$ $C = \frac{1}{2\pi F \times 200} = 0.79\mu F$

40. Extra notes: Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.	Lecturer's name ex: (3-3 hrs) ex: 13/10/4013
41. 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).* ئەم کۆرسبووکە دەبێت لەلایەن هاوەڵێکی ئەکادیمیەوە سەیر بکرێت و ناوەڕۆکی بابەتەکانی کۆرسەکە پەسەند بکات و جەند ووشەیەک بنووسێت لەسەر شیاوی ناوەڕۆکی کۆرسەکە و واژووی لەسەر بکات. هاوەڵ ئەو کەسەیە کە زانیاری هەبێت لەسەر کۆرسەکە و دەبیت پلەی زانستی لە مامۆستا کەمتر نەبێت.	