زانکۆی پۆلیتەکنیکی هەولێر
ERBIL POLYTECHNIC UNIVERSITY

(electric networks) Course Catalogue

2022-2023

institute	**Erbil Technology Collage**	
Department	**Automation Industrial Technology Engineering**	
Module Name	**Electric networks**	
Module Code	**ELN305**	
Semester	**3**	
Credit	**6**	
Module type	**Core**	
Weekly hours	**4**	
Weekly hours (Theory)	**(2)hr Class**	**(81)hr Workload**
Weekly hours (Practical)	**(2)hr Class**	**(69)hr Workload**
Lecturer (Theory)	**Salar Ismael Ahmed**	
E-Mail	Salar.ahmed@epu.edu.iq	
Lecturer (Practical)	**Pshtiwan Kamal Mahmood**	
Email	Pshtiwan.Mahmood @epu.edu.iq	

Course Book

Keywords	Generation& distribution stations, transmission lines, load curves, power factor correction, protection of power system, electrical cables.

Course overview:

This subject is important for the second-year students of electrical power department to let them identify the main electric power system components: generation stations, transmission, distribution and protection of the electric power. Thy will learn about the types of energies and the electrical power generating stations such as: Thermal, hydro and nuclear power stations, the construction and the methods of their operation, the advantage and disadvantages of each, then transmission, distribution of electrical energy with related important electrical networks of the power system components like: types of transmission lines with some mechanical calculations related to them such as span, sag, tension, effect of wind and ice calculations , power losses and the equivalent circuits of transmission line by both methods of T & Π. The students will understand the impotence of the voltage regulation, power factor improvement, load curves and doing the important power calculations. The protection principles.

Course objective:

The aim of this subject is to get the students be familiar about generation, transmission and distribution of electrical energy , the minimizing of the electrical losses by choosing a proper conductor, span, sag for an economical method of distribution, also they will have sufficient knowledge about power stations construction also the type of lines so that the cost is convenient.

The students will be able to calculate the parameters of transmission lines (resistance, inductance and capacitance) voltage regulation calculations, also they will be able to draw the vector diagrams of different lines (short, medium and long), then finding the sending and receiving (voltages, currents, powers, power factors, powers, power factor). The most important theories by reasonably brief outline of essential information, definitions, formulas, procedures with solved examples and unsolved ones for homework.

At the end of the course the student will have sufficient knowledge about power system operation, different measurements and calculations which they need.

Student's obligation

The students should attend the theoretical lectures and study them very well to understand them and ask about any part which is not clear, also the students should have daily examinations about the previous lecture and solve the homework questions.

For the practical part the students should attend in time every week to make the experiment and prepare a report about it, in addition the students should have daily exams about the previous experiment and of course there will exams at the end of each term.

At the end of the year the students should have both practical and theoretical examinations.

Missed classes will not be compensated including the quizzes and the scheduled assignments.

The students will lose marks on unattended classes with quizzes unless a legal

document or authorized leave is presented which should explain the excuse of the absence. However, the absent student should take the responsibility for making up the missed lecture.

Forms of teaching

For teaching this subject the lectures are divided on four weekly hours. Mainly, the first two hours will be dedicated for the topic backgrounds and the main principles. Notes and handouts are given to the students containing the detail of the topics with solved examples and homework. This will be assisted by presentations using word and/or power point slides with writing on the board during the lecture time. Discussion time is provided for the students for questions. The second part of the week is dedicated for teaching the practical part which is related to the theoretical lectures by doing experiments in networks lab to let the students practicing, connecting circuits and measuring the important electrical quantities and theoretically.

Assessment scheme

60% Semester

- **14% Homework (Three home works are the minimum required)**
- **2%Class Activity**
- **10% Report, Seminar, Paper, Essay and Project (Two of them are the minimum required)**
- **14%Lab Report and it's activity (Two of them are the minimum required)**
- **4% Quiz ((Four Quizzes are the minimum required)**

.16% [6% Theory /Mid Term Exam&10% Practical /Mid Term Exam]

40% Final Exam

- **15%Theory**
- **25%Practical**

Student learning outcome:

This course will help the students to be familiar with the different types of electrical power generating stations including (thermal, hydropower, nuclear) stations with the advantage, disadvantage of each one. How to transmit this power to minimize the power losses, main methods of transmission and distribution, calculation of the different types of losses and the (efficiency, voltage drops, voltage regulation, power factor improvement) for (Resistive, Inductive, Capacitive) loads. Principles of protection

The knowledge which they will gain helps them to get jobs in engineering projects, electrical installations, counting electrical tariffs, doing electrical measurements, and reading electrical plans

Course Reading List and References:

At the end of the course the student will have sufficient knowledge about power system		
Course Reading List and References		
Main references	Useful references	Magazines and review (Internet)
1-Electrical Power	1- The Transmission &	1. www.circuits

Transmission & Distribution.	Distribution of Electrical Power/H.cotton,H.barbar	today.com	
2.Acourse in Transmission & Distribution./s.k.GIRDAR-S.M. DHIR	2-ندسة القُوِ الكيربائية/ابراييم يُسف مجيد 3-ملزمة شبكات النظري ًالعملي / -معيد التكنُلجيا اربيل 4- ندسة القُوِ الكيربائية د. محمُد جيالني	2.www.4share .com	
3.Acourse in Electrical power/M.L.SONI	4.Acourse in Electrical power/M.L.SONI	3.www.freebookspot.com	
Principles of power systems V.K Mehta			
4-Power system analysis P.P Doe			

The Topics:	Lecturer's name
Theory	**Salar Ismael Ahmed**

No. Of Weeks	Description
1	Electrical power importance, power system from generation to consumer, standered voltages. Thermal and steam power plants advantage and disadvantages. Hydro power plants, plants between head of the water, and the rate of flow of water. Nuclear power plants, construction advantage and disadvantages. Solar power generation/
2	-load curve calculations.
3	Transmission lines implementations, advantages and disadvantages. parameters of transmission lines (resistance, inductance &capacitance types of Conductors, inductance &capacitance calculations for single line, single phase, three Phase symmetrical & unsymmetrical, transposition process.
4	Mechanical calculations of transmission lines. (same level)
5	Mechanical calculations of transmission lines. (different level)
6	DC transmission its advantages, skin effect Numerical examples on resistance, inductance &capacitance calculations.
7	Geometric mean distance GMD & geometric mean radius GMR
8	Voltage regulation &vector diagrams. Transmission lines types and representation.
9	Different types of ring distribution networks. , radial, ring main -Comparison between different types.
10	Power factor improvement.
11	Feeders and current & voltage drop calculations.
12	Circuit breakers types for (HT, LT).

The Topics:	Lecturer's name
PRACTIC	Salar Ismael Ahmed Pshtiwan Kamal Mahmood

No. Of Weeks	Description
1	To introduce the students instruments used in network lab.
2	Three phase transformer loading by A three phase star connected balanced &unbalance resistive load.
3	Three phase transformer loading by A three phase delta connected balanced& unbalanced resistive load.
4	Three phase transformer loading by A three phase star connected inductive load balanced.
5	Three phase transformer loading by A three phase star connected capacitive load balanced
6	measureing transformers, Current transformers (CT), PT voltage transformers.
7	load curve &calculation of energy, average power, maximum power, load factor
8	O.C.T Calculation of capacitances of A transmission line model (open circuit)
9	9- (Short circuits) for transmission line model impedance calculations.
10	10-Power factor improvement.
11	4- Three phase transformer loading by A three phase star connected inductive load
12	5- Three phase transformer loading by A three phase star connected capacitive load balanced

EXAMINATIONS

Ministry of Higher Education & Scientific Research

Erbil Polytechnic University

Erbil Technology Institute

Class: Second

Subject: Elec .Networks

Time:Two hours

Q1 //**A**- Draw the load curve for following consumers on apower plant during 24 hours and find 1- total energy 2- avarge energy. (13 marks)

Load	20MW	40MW	60MW	20MW	50MW

Time	0 ----8	8 -----12	12 ---- 16	16 ---20	20----24

B - Answer only(**two**) branches :- (12marks)

1- Draw and discuss the effects of transposition for long transmission lines.

2 - Difference between Isolator and Circuit Breaker.

3 - What are the disadvantages of low power factor ?

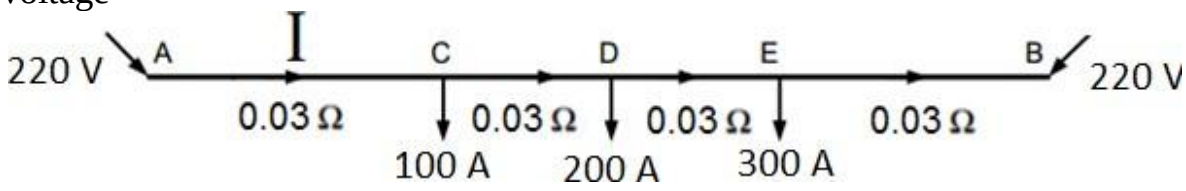
Q2 // A – Find the capacitance rate (C) for three phase load (37.3KW , 440V , 50 Hz) for power factor correction , from $\cos\emptyset_1$ = 0.85 lag to $\cos\emptyset_2$ = 0.95 lag When capacitance connected in 1- Star 2- Delta (15marks)

B - Answer only **one** branch :-

1- Conditions for Parallel Operation of Transformer . (10marks)

2- What are the types of Electrical Substations.

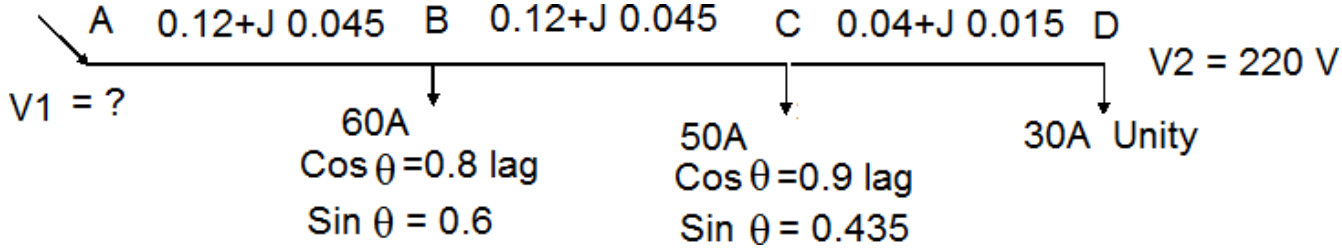
Q3//A - DC distributor shown .Find the currents in each sections and mid-point voltage



(15marks)

B - Answer only **one** branch :- (10 marks)

1 - In the fig shown below find Supply voltage (V1) .

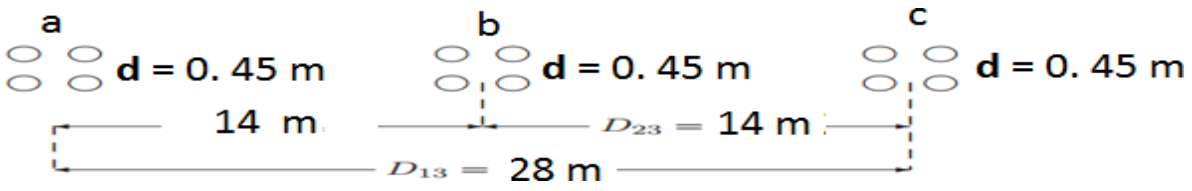


2 - An over head transmission lines three phase (33kV) , (3) insulators

if (m = 0. 11) . Calculate (V1 , V2 , V3 , efficiency)

بۆ لاپەرەی پشتەوە

Q4 //A - Find the inductance (L) of the Four bundle O.H.T.L if (r = 1.14 cm)



(10marks)

B - Fill only (5) five of the following blanks :- (15marks)

1 –The Circuit Breaker types are ---------, ----------,---------- ,----------

2 – The methods of transformers cooling.----------,----------, ----------.

3 - The parameters of transmission lines are --------- , ---------- ,----------, - - - - - -

4 – Reaplaced Cupper by Aluminum in transmission lines because ---------, - - - - - -

5 - The Types of Aluminium Conductors use in transmissions lines------- ,- - - - -,- - - -

6 - The main tyeps of power plant stations ---------- , ----------,----------,- - - - - - -

((good luck and best wishes))

Ministry of Higher Education & Scientific Research

Erbil Polytechnic University

Erbil Technology Institute

Academic year: 2018 – 2019

Class: Second

Subject: Elec .Networks

Time:Two hours

Q1 / A- The following consumers on apower plant during 24 hours (10marks)

Draw the load curve

Load	10MW	20MW	30MW	40MW	40 MW	30MW	20MW	10MW
Time	0 ---- 3	3 ----- 6	6 ----- 9	9 ----12	12 --- 15	15 ---- 18	18 --- 21	21--- 24

B // Choose the correct answer of the following :-

(15 marks) **1-** For 33 kV transimission lines the number of insulator discs used are

a - 3 numbers b - 5 numbers C - 8 numbers

2- Which of the following voltage regulation is be the best.

a- 2% b - 30% C - 90%

3- The terminals which connect the consumer's terminals to the distributors called

a- Distributors b- Feeders C- Service mains

4 - A 30 km transmission line carrying power at 33 kV is known as

a- midium transmission line b- long TR.L C - short TR.L

5- It used to step down the current of power system to a lower level to be measured by small rating Ammeter

a- Current transformer (C.T.) b- Voltage transformer (V.T.) C- circuit breker

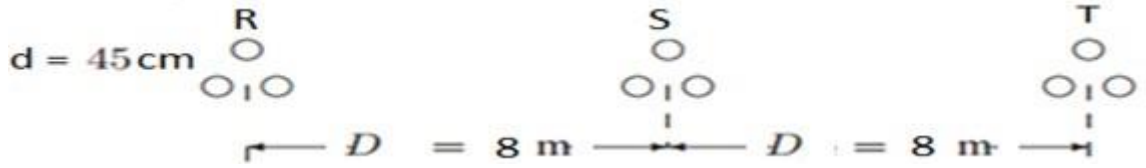
Q 2 // A - Answer only **(two)** branches :-

(15marks)

1- Draw the Bus-Bar types Arrangements
2- Draw the low voltage (L.V.) distribution system .
3- Types of Electrical Power stations.
4- Advantages of using capacitors banks for Powe Factor correction.

(10marks)

B - Find the inductance (L) of the three bundle O.H.T.L if (r = 1.14 cm)



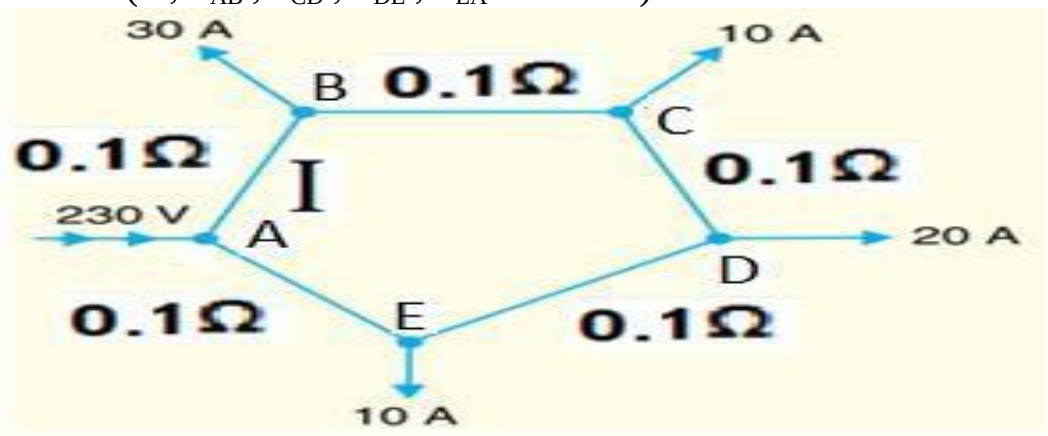
Q3 // Answer only (**two)** branches :-

(30 marks)

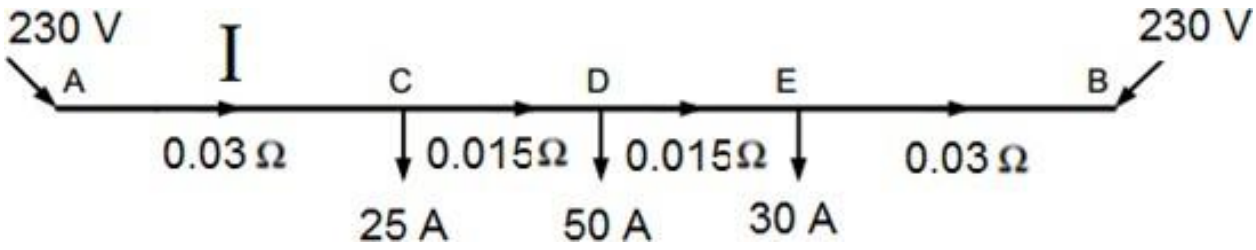
1– An O.H.T.L three phase (33 kv) , (3) insulators if (V3 = 8.286 kv ,V2 = 5.917 kv)

Calculate (V1 , ratio of shunt to self capacitance (m) , effeicincy (η) .

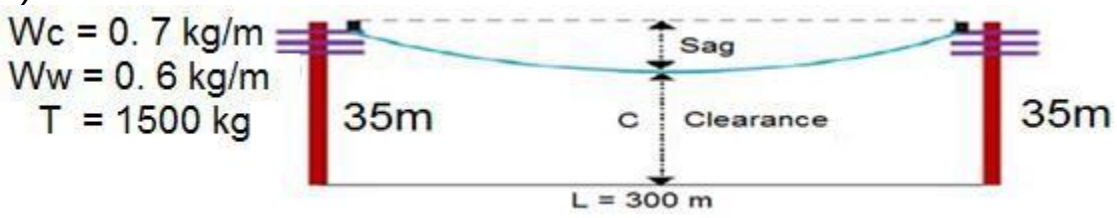
2 - DC ring distributors shown calculate currents in each sections with diagram.
(I , I_{AB} , I_{CD} , I_{DE} , I_{EA} and VD)



3 - DC distributor supplied from two ends
Calculate (I , I_{CD} , I_{DE} , I_{EB} , and V minimum Voltage point)



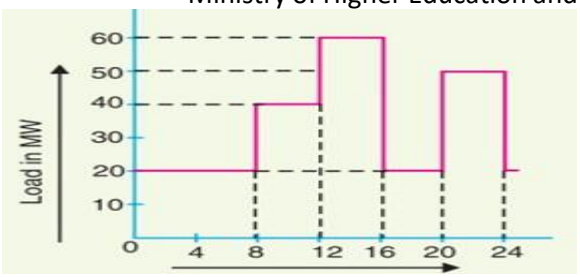
Q4 // An O.H.T.L, same level as shown below (20 marks) Calculate (Sag , vertical sag , clearance (C).



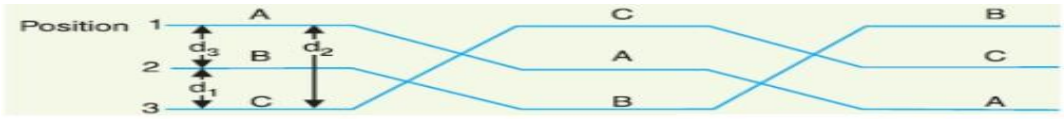
((good luck and best wishes))

أجُبة Exam: (First Attempt) Academic year: 2018 – 2019 الدور االول

Q1/A



B//1-



$$L/phase = 0.05 + 0.2\,L_n \frac{D}{r}$$

اذن

$$D_3 \neq D_2 \neq D1$$

$$L_3 \neq L_2 \neq L_1$$

$$X_{L3} \neq X_{L2} \neq X_{L1}$$

$$Vd\,1 \neq Vd2 \neq Vd3$$

$$Vr1 \neq Vr2 \neq Vr3$$

an exchange of positions is known as transposition

$$D\ eq. = \sqrt[3]{D_1 D_2 D_3}$$

2-

Isolator	Circuit Breaker
1- off load device	1- on load device
2- operated manually	2- operate automatically
3- low capacity	3- high capacity

3-

Disadvantages of Low Power Factor $\cos\theta$ ⇩

1- $S = \frac{P}{\cos\theta}$ KVA ⇧

2- Line Current I ⇧

3- Cross Section of Conductor A mm^2 ⇧

4- Copper Loss = I^2R ⇧

5- Efficiency ⇩

6 - Voltage Regulation ⇧

$$\uparrow VR = \frac{\uparrow I R\cos\theta + \uparrow I X\sin\theta}{V}$$

Q2// A

B//1-

1. **Same voltage and Turns Ratio**
2. **Same KVA ratings**
3. **Same Phase angle shift**
4. **Same Frequency rating**
5. **Same Polarity**
6. **Same Phase sequence**

2-

1. Step Up 2- Step Down 3- Primary Step Down 4- Secondary Step Down

5- Outdoor Type 6- Indoor 7- underground Substation

Q3// B//

1-

2-

V phase = 33 / $\sqrt{3}$ = 33/ 1.732 = 19. 053 kv

V1= V phase /(3 + 4 m + m^2) = 19. 053 kv / (3+ 4 X 0.11+ 0.11^2)

V1 = 19. 053 kv / 3 + 0.452 = 19. 053 kv / 3.452 = 5.519 kv

V2 = V1(1 + m) = 5.519 (1+ 0.11) = 5.519 x 1.11 = 6.126 kv

V3= V1 (1 +3 m+ m^2) = 5.519 x(1+ 3 x 0.11 + 0.11^2) = 5.519 x 1.342 = 7.4 kv

Efficiency = V phase / 3 V3 = 19. 053 / 3 x 7.4 = % 86

Q4// A

$$GMD = \sqrt[3]{(14)(14)(28)} = 17.63889 \text{ m}$$

$$GMR_L = 1.02\sqrt[4]{rd^3} = 1.02\sqrt[4]{(1.4173)(45)^3} = 20.66 \text{ cm}$$

$$L = 0.2 \ln \frac{GMD}{GMRL} = 0.2 \ln \frac{17.63889}{0.2066} = 0.889 \text{ mH/Km}$$

B//

1- Vacum, sf6,oil,air

2- **(ONAN) ,ONAF ,OFAN, OFAF, ONWF, OFWF**

3- **R,L,C,G**

4- **Low cost,low weight**

5- AAC ,AAAC , ACSR , ACAR , AAACSR,

Thermal , -Hydro ,Nuclea ,Gas ,Diesel , Solar ,Wind

20. Extra notes:

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21. Peer review

The course book has been reviewed by me. It's well prepared for academic purpose and suitable for education of technology institute students

Reviewer's Name:_____nawal pato kano _____

Title:_____Lecturer _____ Date ____10/10/2020____

زانكۆی پۆلیتەکنیکی هەولێر
ERBIL POLYTECHNIC UNIVERSITY

Erbil Technology Institute					
Program: Diploma (120 ECTS)					
Total No. of Weeks/Semester:	16 weeks				
Department name:	Department of Electricity		X	Y	Z
Module Name:	Electrical Networks		2	2	0
Module Code:	ELN305				

ECTS Workload Calculation Form

Activity	S	Description		Activity Type	No.	Time Factor	Workload
Course	1	Theory	In class	f	12	2	24
	2		Online	f			0
	3	Preparation (1.5 theory)		h	12	3	36
	4	Practical		f	12	2	24
	5	Preparation (0.5 practical)		h	12	1	12
	6	Tutorial		f	12	0	0
Assignment	7	Homework		h	3	1.5	4.5
	8	Report		h	9	2	18
	9	Seminar		h	1	3	3
	10	Paper		h		8	0
	11	Essay		h		6	0
	12	Project		h		8	0
Assessment	13	Quiz		h	5	0.5	2.5
	14	Mid Term	Theory	f	1	2	2
	15		Preparation	h	1	6	6
	16		Practical	f	1	1	1
	17		Preparation	h	1	4	4
	18	Final	Theory	f	1	2	2
	19		Preparation	h	1	6	6
	20		Practical	f	1	1	1
	21		Preparation	h	1	4	4
Face to face hours (f)/12 week			4.50	Face to face hours (f)			54
Home hours (h)/16 week			6.00	Home hours (h)			96
Total hours/16 week			9.38	Total hours			150
ECTS (Total hours/ 25)							6

*f: Face to face activity hours   h: Household activity hours
X: Theoretical class hours/ week   Y: Practical hours/ week   Z: Tutorial hours/ week
** Underlined numbers must not be changed.

Hussain A. Ibrahim