UNIVERSITY OF SWAZILAND
SUPPLEMENTARY EXAMINATION, JULY 2016

FACULTY OF SCIENCE AND ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

TITLE OF PAPER:	**POWER SYSTEMS**
COURSE NUMBER:	**EE452**
TIME ALLOWED:	**THREE HOURS**

INSTRUCTIONS:

1. There are four questions in this paper. **Answer ALL questions.**
2. Each question carries 25 matks.
3. Marks for different sections of a question are shown on the right hand margin.
4. If you think not enough data has been given in any question you may assume any reasonable values.
5. A sheet with selected formulae, some of which you may need, is attached at the end of the question paper.

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THIS QUESTION PAPER HAS SIX (6) PAGES INCLUDING THIS PAGE

QUESTION 1 ***(25 marks)***

A three-phase transmission line is connected to a load of 250 MVA at lagging power factor of 0.8 at 220 kV line-to-line voltage. The per phase total series impedance of the line is $Z = 4 + j60\ \Omega$ and per phase total shunt admittance $Y = j5\times10^{-4}$ S.

(a) Determine, giving reasons, whether this line is considered short, medium or long. *(2 marks)*

(b) Use the π-model of the line to determine the following:

- **(i)** *ABCD* constants of the line *(7 marks)*
- **(ii)** The sending end voltage and current *(11 marks)*
- **(iii)** The sending end power factor *(2 marks*
- **(iv)** The percentage voltage regulation *(3 marks)*

QUESTION 2 ***(25 marks)***

(a) A three-phase load draws 150 kW at 0.75 p.f. lagging from a distribution line having 400 V line-to-line voltage. If a three-phase capacitor bank that supplies a total of 50 kVAR is connected in parallel with the load, determine:

(i) The resulting power factor. *(11 marks)*

(ii) The line current before and after connecting the capacitors. *(4 marks)*

(b) **(i)** Define the terms: **Demand Factor** and **Diversity Factor** as used in the supply of electrical energy to consumers. *(2 marks)*

(ii) A distributor line supplies three transformers, each of which supplies a group of customers. The total connected loads, demand factors and diversity factors of the groups connected to each transformer are as follows:

Transformer	Connected load	Demand Factor	Diversity Factor
TR1	200 kW	0.6	2.5
TR2	150 kW	0.8	1.8
TR3	120 kW	0.7	2.0

a. Calculate the maximum demand on each transformer. *(6 marks)*

b. If, in addition, the diversity factor among the three distribution transformers is 1.4, calculate the maximum demand on the distributor line. *(2 marks)*

QUESTION 3 ***(25 marks)***

(a) A single-phase distributor is 3 km long and supplies a load of 100 A at 0.8 p.f. lagging at the far end, and a load of 60 A at 0.75 p.f. lagging at 1 km from the sending end. . The loop resistance and reactance per kilometre (to and fro) of the line is 0.01 +j0.1 Ω. If the voltage at the far end is maintained at 230 V, calculate:

(i) The sending end voltage. *(9 marks)*

(ii) The phase angle between the voltages at the two ends of the line. *(1 mark)*

(b) A three-phase 400-kV, 50-Hz transmission line is 300 km long and may be assumed **lossless**. The line is energized with 400 kV line-to-line voltage at the sending end. When the load at the receiving end is removed, the line-to-line voltage at the receiving end rises to 650 kV, and the sending end current is $600\angle 90^\circ$ A per phase.

(i) Determine:

a. The phase constant β in radians per km, *(4 marks)*

b. The surge impedance Z_C. *(2 marks)*

(ii) Ideal shunt reactors are to be installed at the receiving end to keep $|V_S| = |V_R| = 400$ kV when the load is removed. Determine

a. The shunt reactance required per phase, *(5 marks)*

b. The required three-phase MVAR of the reactors. *(2 marks)*

(iii) What is the Surge Impedance Loading (SIL) of the line? *(2 marks)*

QUESTION 4 ***(25 marks)***

(a) A bundled conductor is made up of four equal strands (sub-conductors) arranged as shown in the cross-sectional diagram of Fig. Q.4a. Each of individual strand has radius *r*. Show that the Geometric Mean Radius (*GMR*) of the bundled conductor:

(i) For calculating inductance, GMR_L, is given by 1.7229*r* *(7 marks)*

(ii) For calculating capacitance, GMR_C, is given by 1.8340*r* *(3 marks)*

(iii) Why is GMR_L not equal to GMR_C? *(2 marks)*

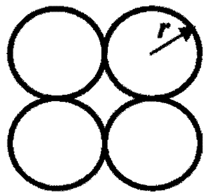

Fig. Q.4a

(b) The cross-sectional diagram of a three-phase transmission line is as shown in Fig. Q.4b. Each conductor of the line is made up of 4 strands, arranged as described in Q.4(a). The radius of each individual strand is 1.5 cm. Assume that the line is fully transposed. To simplify the analysis you may assume that the spacing between the conductors is much greater than the radius of a strand.

$$\mu_o = 4\pi \times 10^{-7} \text{ H/m}$$
$$\varepsilon_o = 8.854 \times 10^{-12} \text{ F/m}$$

(i) Determine the inductance per phase per kilometer of the transmission line. *(6 marks)*

(ii) Determine the capacitance to neutral per phase per kilometer of the line, neglecting the effects of ground proximity. *(3 marks)*

(iii) If the line is 180 km long and is maintained at 220 kV, 50 Hz, calculate the charging current per phase of the line. *(4 marks)*

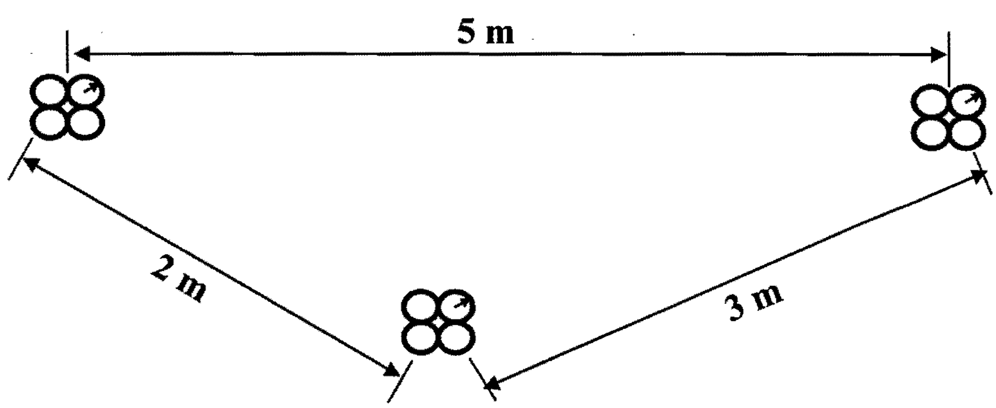

Fig. Q.4b

SUMMARY OF TRANSMISSION LINE *ABCD* CONSTANTS

Parameter	$A = D$	B	C
Units	p.u.	Ω	S
Short Line $G=C=0$	1	Z	0
Medium Line $G=0$ (π-model)	$1+\frac{YZ}{2}$	Z	$Y\left(1+\frac{YZ}{4}\right)$
Long Line (length l, equivalent π-model)	$\cosh(\gamma l)=1+\frac{Y'Z'}{2}$	$Z_c\sinh(\gamma l)=Z'$	$\frac{1}{Z_c}\sinh(\gamma l)=Y'\left(1+\frac{Y'Z'}{4}\right)$
Lossless Line (length l, $R=G=0$)	$\cos(\beta l)$	$jZ_c\sin(\beta l)=jX'$	$\frac{j\sin(\beta l)}{Z_c}$

Equivalent π-model of long line:

$$Z' = Z_C \sinh\gamma\ell = Z\frac{\sinh\gamma\ell}{\gamma\ell}, \qquad \frac{Y'}{2}=\frac{1}{Z_C}\tanh\frac{\gamma\ell}{2}=\frac{Y}{2}\frac{\tanh\gamma\ell/2}{\gamma\ell/2}$$

Equivalent π-model of lossless line: $Z' = jX' = jZ_C\sin\beta\ell,\qquad \frac{Y'}{2}=j\frac{\sin\beta\ell}{Z_C}$

For lossless line:

$Z_C=\sqrt{L/C}$ Ω, $\beta=\omega\sqrt{LC}$ rad/m, $v=1/\sqrt{LC}$, Note here L is inductance/unit length

$SIL = 3V_R I_R^* = 3|V_R|^2/Z_C = (V_{LLrated})^2/Z_C$ W

Overhead Transmission lines:

$$L=\frac{\mu_o}{2\pi}\ln\frac{GMD}{GMR_L}, \qquad C=\frac{2\pi\varepsilon_o}{\ln\frac{GMD}{GMR_C}}$$

Injection of VARs into a Short Transmission Line results in:

$$V_S^2=\left[V_R+I_pR-(I_m-I_q)X\right]^2+\left[I_pX+(I_m-I_q)R\right]^2$$

where $I_R = I_p - jI_q$

University of Swaziland
Faculty of Science and Engineering
Department of Electrical and Electronic Engineering
Supplementary Examination 2016

Title of Paper	**:**	**Computer Networks**
Course Number	**:**	**EE572**
Time Allowed	**:**	**3 hrs**
Instructions	**:**	

1. **Answer all four (4) questions**
2. **Each question carries 25 marks**

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The paper consists of three (3) pages

Question 1

(a) Packet switching is used in layer 3; state the difference between the two approaches that are used, virtual circuit and datagram approach? [6]

(b) What are the differences between message confidentiality and message integrity? [6]

(c) The OSI model is the standard model for communication in the ICT era. Draw the model and significantly explain what takes place at each layer (functions of each OSI layer)? [9]

(d) In open-loop congestion control, policies are applied to prevent congestion before it happens. State four (4) policies that can be implemented? [4]

Question 2

(a) Using the error control techniques, differentiate between Go-Back-N ARQ and Selective Repeat ARQ? [6]

(b) What is the main difference between TCP and UDP? [1]

(c) What is the difference between the basic rate ISDN (BRI) and Primary rate ISDN (PRI) [4]

(d) Your company has been just assigned the network 192.168.10.0/27. How many subnets (IP range) and hosts-per-subnet you can create with a subnet mask of 255.255.255.252? [6]

(e) Explain how reservation and token passing works as part of the controlled access techniques. In token passing, explain how is the right to access the channel passed from one station to another? [8]

Question 3

(a) In wireless LANs collision is avoided by the use of the network allocation vector (NAV). Explain how that works in wireless LANs. [3]

(b) Discuss these two application layer protocols: SMTP and FTP. Clearly state their purpose, ports used, etc. [10]

(c) Two processes in client-server model can interact in various ways. Explain how a socket works in this model. [5]

(d) Explain the three way handshaking in the transport layer. [4]

(e) Create an extended access-list to deny FTP access from network 200.200.10.0 to network 200.199.11.0 but allow everything else. [3]

Question 4

(a) Explain two node instability problem in distance vector routing algorithms and state how it can be resolved. [5]

(b) In mobile IP, how do agents discovery takes place [3]

(c) Explain the difference between error correction and error detection. Which approach requires more information? [5]

(d) Using the persistence methods explain how a non-persistent station differs from a p-persistent station? [5]

(e) Distinguish between unicast, broadcast, and multicast. [5]

(f) In the standard Ethernet with the transmission rate of 10 Mbps, we assume that the length of the medium is 2500 m and the size of the frame is 512 bits. The propagation speed of a signal in a cable is normally $2x\ 10^8$ m/s. Calculate the efficiency? [2]