The Open University of Sri Lanka
Diploma in Technology
ECD 1214 [ECE 3214] Introduction to Electrical Power
Final Examination-2005

044

Duration Three Hours
Date: May 02nd 2006 **Time: 0930-1230 hrs.**

This paper contains Eight (8) questions. Answer any five (5). All questions carry equal marks. Graph papers will be available on your request.

1. The flux Φ linked by a coil of 100 turns varies during the period **T** of one complete cycle as follows;

   From t = 0.0 to t = T/2, $\Phi = \Phi_m\left(1 - \frac{4t}{T}\right)$; and

   From t = T/2 to t = T, $\Phi = \Phi_m\left(\frac{4t}{T} - 3\right)$.

   If **T** be 1/50 sec., and Φ_m be 2 mega lines, calculate the maximum value of the induced electromotive force. Plot to scale the flux and electromotive force waves.
   (Assume that 10^8 mega lines = 1 wb)

2. Two domestic consumers "A" & "B" are fed by a certain local electricity supply metered at 400V/230V. Variation of their daily load patterns (including week-ends & holidays) are as given below:

Consumer A

From	midnight	to	7.00 a.m.	250 W
	7.00 a.m.	to	6.00 p.m.	No load
	6.00 p.m.	to	7.00 p.m.	2500 W
	7.00 p.m.	to	9.00 p.m.	4000 W
	9.00 p.m.	to	mid night	500 W

Consumer B

From	midnight	to	9.00 a.m.	500 W
	9.00 a.m.	to	12.00 noon	200 W
	12.00 noon	to	5.00 p.m.	700 W
	5.00 p.m.	to	7.00 p.m.	No load
	7.00 p.m.	to	mid night	3500 W

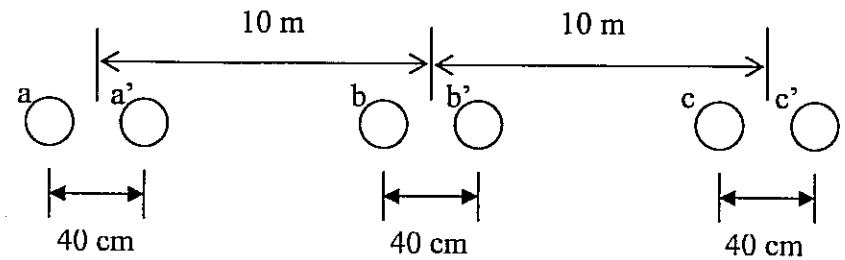
   a) Plot the load variation during 24 hours for each consumer?
   b) Hence find out the maximum and minimum demand for each consumer?
   c) Plot the total load variation during 24 hours and hence find the maximum power that has to be delivered by the electric supplier
   d) Compute the energy consumption by each consumer, and hence prepare the monthly electricity bill for each consumer (You may use the attached tariff table for the computation of monthly electricity charges)

3. The efficiency, at unity power factor (p.f.=1), of a 6600/384 V, 200 kVA, single phase transformer is 98% both at full-load and half-load. The power factor on no-load is 0.2. The full-load regulation at a lagging-power factor of 0.8 is 4%. Draw the equivalent circuit referred to the low voltage side and show all the values of the parameters.

Hint: You may neglect the magnetizing branch when doing the voltage reg. calculation.

Also assume that $\left[\text{Voltage regulation} = \frac{(V_S - V_R)}{V_S} \approx \frac{(I.R.\text{Cos}\varphi + I.X.\text{Sin}\varphi)}{V_S}\right]$

4.



(a) Calculate the inductance per phase per km of the above 132 kV transmission line conductor configuration. Conductor radius is 2 mm.

(b) Calculate the equivalent radius of a conductor for each phase which would give the same value as in part (a) for the inductance, if the single conductors are to be placed at the centre points of the present double conductors.

5. Three 1Φ loads are connected to a 2000 kVA transformer as shown below in fig. Q5. Copper loss and iron loss when delivering the rated power are 40 kW and 22 kW respectively. Behavioral pattern of the loads connected to the transformer during a normal working day is given in table Q5.

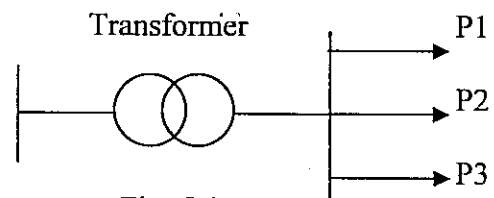


Fig. Q5

Table Q5

Time	Load-1 (P1)		Load-2 (P2)		Load-3(P3)	
	P(kW)	cos(ø)	P(kW)	cos(ø)	P(kW)	cos(ø)
6.00 a.m. - 12.00 noon	400	0.8	100	0.75	300	0.9
12.00 noon - 4.00 p.m.	600	0.9	300	0.85	450	0.95
4.00 p.m. -9.00 p.m.	250	0.9	400	0.95	700	1.00

6. A suspension insulator string is shown in Fig Q6 together with its associated capacitances. The conductor voltage is V.

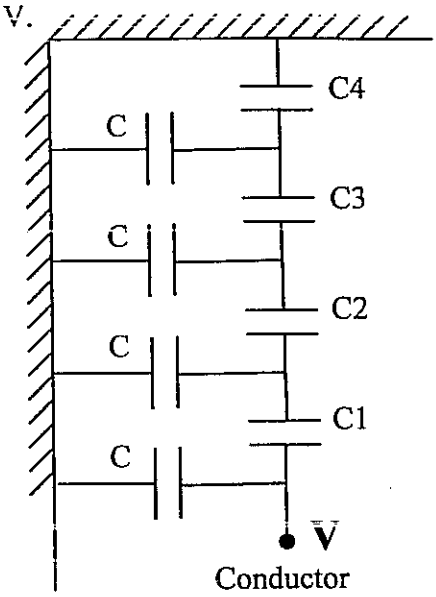


Fig. Q6

Calculate the voltage distribution and sting efficiency Under the following conditions:

(a) $C_1 = C_2 = C_3 = C_4 = 10$ C

(b) $C_1 = C_2 = 15$ C and $C_3 = C_4 = 10$ C

Comment on the above results.

7. Find ABCD constants of a nominal π network model of a transmission line.
A 3Φ, 50 Hz, 100 km overhead transmission line has the following line constants per km.

Resistance = 0.153 Ω inductance = 1.21 mH capacitance = 0.00958 μF

The line supplies a load of 20 MW at 0.9 power factor lagging at a line voltage of 110 kV at the receiving end. Using a nominal π representation, calculate sending end voltage, current, power factor, voltage regulation and efficiency.

8. A 3Φ, 500 V, 50 cycles/sec induction motor with 6 poles develops 20 h.p at 950 rev/min with a power factor of 0.86. The mechanical losses totals 1 h.p. calculates for this load:

a) The moor slip (s)
b) The rotor copper loss
c) The input power to the motor, if the stator (wdg. + core) losses is 1500 Watts
d) The line current.

(Assume 746 watts = 1 hp)

Tariff table for Q2

Customer Category	Conditions	Maximum demand charge Rs./kVA per month	Energy Charge Rs./kwh	Fixed Charge Rs./month
Domestic	Metered at 400V/230V	-	0-30 Units @ 3.00 31-60 Units @ 3.70 61-90 Units @ 4.10 91-180 Units @ 10.60 Above 180 Units @ 15.80	30.00
Religious	Metered at 400V/230V	-	0-30 Units @ 2.50 31-90 Units @ 2.70 91-180 Units @ 4.00 Above 180 Units @ 7.20	30.00
General Purpose All buildings except industries & some hotels	Metered at 400V/230V contract demand < 42 kVA Demand up to 10 kVA Demand above 10 kVA	-	 10.90 10.90	 30.00 230.00
	contract demand > or = 42 kVA Metered at 400V/230V Metered at 11/33/132 kV	 480.00 460.00	 10.80 10.70	 800.00 800.00
Industrial Includes some hotels	Metered at 400V/230V contract demand < 42 kVA Demand up to 10 kVA Demand above 10 kVA	-	 7.50 7.50	 30.00 230.00
	contract demand > or = 42 kVA Metered at 400V/230V Metered at 11/33/132 kV	 400.00 380.00	 7.10 7.00	 800.00 800.00
Industrial Time Of Day Includes some hotels	Metered at 400V/230V contract demand < 42 kVA Demand up to 10 kVA Demand above 10 kVA	-	 15.00 bet 7-10 p.m. 6.90 at other times	 30.00 230.00
	Metered at 400V/230V contract demand > or = 42 kVA	380.00	14.70 bet 7-10 p.m. 6.50 at other times	800.00
	Metered at 11/33/132 kV contract demand > or = 42 kVA	360.00	14.00 bet 7-10 p.m. 6.10 at other times	800.00
Supplies to licensees LECO/LA	Supply at 400/230 V Supply at 11k V & above	240.00 220.00	7.20 5.40	-
Standby Tariff	Supply at 400/230 V Supply at 11k V & above	100.00 90.00	7.10 7.00	800.00 800.00
Street Lighting	-	-	7.80	-