UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2017/2018

COURSE NAME	:	POWER GENERATION, TRANSMISSION AND DISTRIBUTION
COURSE CODE	:	BEF 36003
PROGRAMME CODE	:	BEV
EXAMINATION DATE	:	DECEMBER 2017 / JANUARY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) (i) List **two (2)** advantages of distributed generation.

(2 marks)

(ii) Draw the main components of stand-alone photovoltaic system.

(3 marks)

(b) A hydro power station has a reservoir of area 1.5 km^2 and capacity 4×10^6 m^3. The effective head of water is 200 m. The penstock, turbine and generation efficiencies are 95%, 95% and 80% respectively. Calculate,

(i) the total efficiency of the system.

(2 marks)

(ii) the total electrical energy that can be generated (kWh) from the power station.

(4 marks)

(iii) the fall in reservoir level if a load of 20,000 kW has been supplied for 5 hours.

(5 marks)

(c) A generating station has an installed capacity of 100 MW and delivers 150 GWh per annum. If the annual fixed charges are RM 200 per kW installed capacity and running charges are RM0.05 per kWh. Determine the cost per unit generated.

(4 marks)

Q2 (a) An insulator string for 33 kV line has 3 discs. The shunt capacitance between each insulator pin and earth is 13% of self-capacitance of each insulator. Find the voltage across the different discs.

(7 marks)

(b) Corona is the phenomena of violet glow, hissing noise and production of ozone gas in an overhead transmission line. As an electrical engineer, briefly explain the methods to reduce the corona effect.

(4 marks)

(c) An overhead transmission line conductor having a parabolic configuration weights of 1.925 kg/m of length with the ice load is 1 kg/m run. The towers are 600 m apart having 15 m difference of levels with the tension in the conductor of 3520 kg.

(i) Sketch the towers diagram with the information given.

(2 marks)

(ii) Calculate the distance between the sag and the taller of the two towers.

(7 marks)

Q3 (a) Electric power of 50 MW is to be transmitted over a 132 kV line. The length of the line is 300 km and the efficiency of transmission is 85%. Aluminium is used for conductor material which has resistivity of 3×10^{-9} Ωm. For a power factor of 0.8 lagging, calculate the volume of aluminium conductor required for the line when:

(i) single phase, 2 wire system is used.

(5 marks)

(ii) three phase, 3 wire system is used.

(5 marks)

(b) (i) Explain the importance of transposition in transmission line for unsymmetrical spacing conductor.

(2 marks)

(ii) Draw the transposition method of **three (3)** wire transmission line system.

(3 marks)

(iii) A three phase, three wire system has conductors arranged in a horizontal plane as shown in **Figure Q3(b)(iii)** with spacing of $D_{12} = D_{23} = 2.5$ m and $D_{31} = 5$ m. The conductors are completely transposed and have a diameter of 3.0 cm. Determine the inductance of each conductor per km.

(5 marks)

Q4 (a) A three-phase, 50 Hz, completely transposed 200 km line has two 795,000-cmil 26/2 ACSR conductors per bundle and the line constants are given as:

Resistance/phase/km = 0.1 Ω
Reactance/phase/km = 0.5 Ω
Susceptance/phase/km = $j10^{-5}$ S

The full load condition at the receiving end of the line is 20 MW at 0.8 lagging power factor and 66 kV. Given the calculated ABCD parameters of the nominal π line model as follows:

$$A = D = 1 + \frac{ZY}{2} = 0.9002\angle 1.27^0$$

$$B = Z = 101.98\angle 78.69^0\ \Omega$$

$$C = Y\left(1 + \frac{ZY}{4}\right) = 1.9001 \times 10^{-3}\angle 90.60^0$$

(i) Determine the sending end voltage and voltage regulation of the line.

(5 marks)

(ii) If the above transmission line delivers 20 MVA at unity power factor to the load, compare and discuss the new voltage regulation of the transmission line with the one obtained in **Q4 (a)(i)**.

(5 marks)

(b) Power factor of an AC electrical power system is defined as the ratio between the load's real power to the apparent power in the circuit. Briefly explain **two (2)** demerits of a system with power factor equal to 0.7.

(4 marks)

(c) An alternator is supplying a load of 140 kVAR at 0.85 lagging power factor. If the power factor is raised to unity, determine the increase of power can supply by alternator for the same kVA loading.

(6 marks)

Q5 (a) Briefly explain the **three (3)** primary distribution lines circuits with appropriate diagram.

(6 marks)

(b) A single phase distributor one km long has resistance and reactance per conductor of 0.1 and 0.15 ohm respectively. At the far end, the voltage $V_B = 200$ V and the current is 100 A at p.f. of 0.8 lagging. At mid-point M of the distributor, a current of 100 A is tapped at p.f. of 0.6 lagging with reference to the voltage V_M at the mid-point.

(i) Calculate the voltage at mid-point.

(6 marks)

(ii) Calculate the sending end voltage.

(5 marks)

(iii) Analyze and discuss the phase angle between V_A and V_B.

(3 marks)

- **END OF QUESTIONS** -

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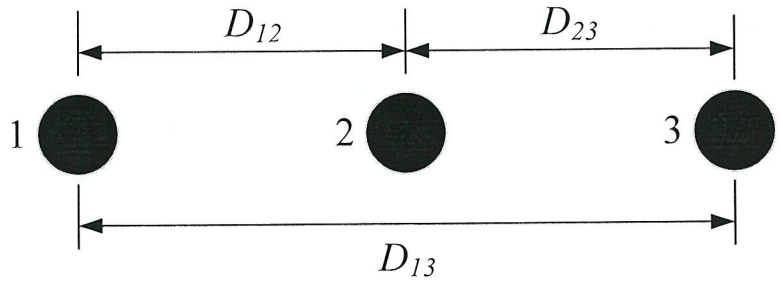

Figure Q3(b)(iii)