UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: BET 3083
COURSE	: POWER GENERATION, TRANSMISSION AND DISTRIBUTION
SEM/SESSION	: 1 –2024/2025 (FLEXIBLE)
DURATION	: 3 HOURS

Instructions:

1. This booklet contains **4** questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 7 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

a) State the purpose of electric power system with diagram (5 marks)

b) Discuss three (3) purposes of transmission and distribution in electric power system respectively. (6 marks)

c) The energy conversion can be categorized as conventional sources and renewable sources.

i. Differentiate conventional and renewable source. (2 marks)

ii. List four (4) examples for each category of the source. (4 marks)

d) National Grid in Malaysia is operated and owned by Tenaga Nasional Berhad (TNB). State four (4) advantages of having National Grid in Malaysia (4 marks)

e) A large commercial electrical bill demand is 436 KW, use in 57,200kwH, and number of days in billing cycle is 32. Using the given equation, calculate the load factor. (3 marks)

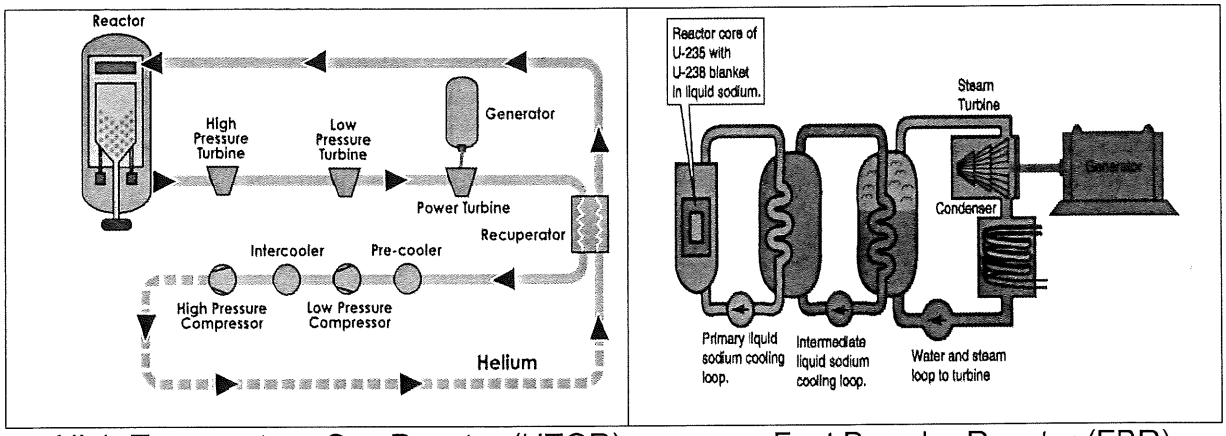
$$f_{load} = \frac{Average\ load}{Maximum\ load\ in\ given\ time\ period}$$

f) National Grid is the primary electricity transmission network linking in Malaysia. Describe four (4) functions of national grid in power system. (4 marks)

QUESTION 2

a) List three (3) main types of generating station. (3 marks)

b) Refer to Figure 1, differentiate the High Temperature Gas Reactor (HTGR) and Fast Breeder Reactor (FBR). (4 marks)



High-Temperature Gas Reactor (HTGR) Fast Breeder Reactor (FBR)

Figure 1

c) Hydropower generating stations convert the energy of moving water into electrical energy via its hydraulic turbines which is coupled to a synchronous generator.

i. Draw the structure of a hydropower plant (5 marks)

ii. Explain function of three (3) basic components in hydropower plant (6 marks)

QUESTION 3

a) Transmission lines can be classified into three groups which are short transmission line, medium transmission line and long transmission line.

i. Define the short transmission line. (2 marks)

ii. Draw the short transmission line model on per phase complete with label . (4 marks)

b) A 40 km long, short transmission line has $0.5\angle 60^0\Omega$/km impedance. The line supplies a 313.2 kW load at 0.85 power factor leading. Calculate the voltage regulation if the receiving end voltage is 3.6kV. (8 marks)

c) A 60 Hz short transmission line, having R= 0.62 Ω per phase and L = 93.94 mH per phase, supplies a three phase, wye-connected 100 MW load of 0.9 lagging power factor at 215 kV line to line voltage. Calculate :

i. The sending end voltage, V_S and current per phase, I_R. (6 marks)

ii. The sending end power and line efficiency. (4 marks)

d) A 345 kV, three-phase transmission line is 130 km long. The resistance per phase is 0.036 Ω per km and the inductance per phase is 0.8 mH per km. The shunt capacitance is 0.0112 μF per km. The receiving end load is 270 MVA with 0.8 power factor lagging at 325 kV. Use the medium line model to calculate :

i. The sending end voltage (8 marks)

ii. The sending end power (2 marks)

iii. The voltage regulation. (2 marks)

QUESTION 4

a) A 30 MVA, 13.8 kV three-phase generator has a subtransient reactance of 15%. The generator supplies two motors over a transmission line having transformers at both ends, as shown in Figure 2. The motor have rated inputs of 20 MVA and 10 MVA, both 12.5 kV with x=20%. The three-phase transformer T1 is rated 35 MVA,(Δ/Y) 13.2 - 115 kV with leakage reactance of 10%. Transformer T2 is composed of three single-phase transformers each rated at 10 MVA,(Δ/Y)12.5- 67 kV with leakage of 10%. Series reactance of the transmission line is 80 Ω. Design the reactance diagram with all reactance marked in per unit. Select the generator rating as base in the generator circuit. (14 marks)

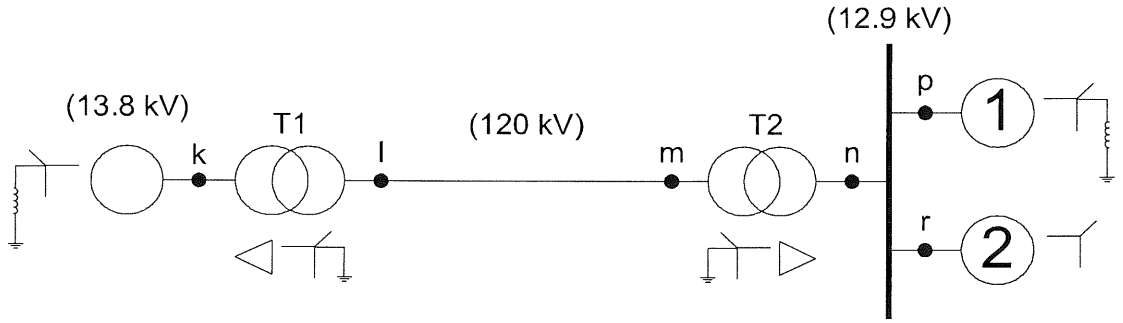


Figure 2

b) One line diagram are widely used in three phase power system studies as shown in Figure 3.

i. State two (2) advantages of one line diagrams. (2 marks)

ii. Simplify the one line diagrams in Figure 2 into a reactance diagram. (3 marks)

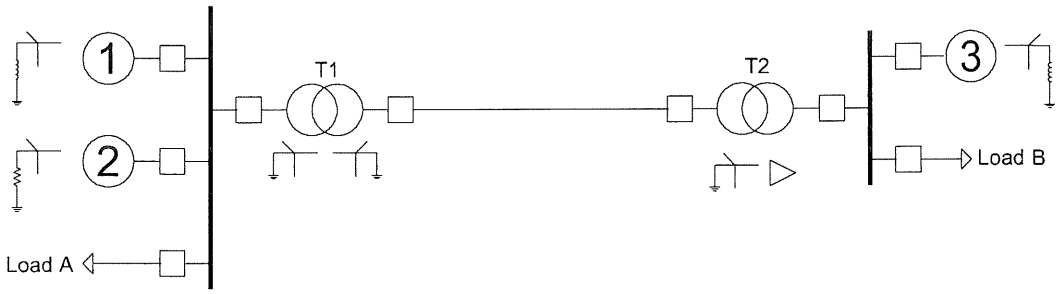


Figure 3

.....END OF QUESTION.....

LIST OF FORMULA

Short line

$$V_S = AV_R + BI_R$$
$$I_S = CV_R + DI_R$$

$$P = gqh$$

$$XL = j2\Pi fL$$

$$Z=(r+j\omega L)\ell$$

$$V_{R(L)} = \frac{V_{R(LL)}}{\sqrt{3}}$$

$$I_R = \frac{S^*_{R(3\emptyset)}}{3V_{R(LN)}}$$

$$S_{R(3\emptyset)} = \frac{P_{3\emptyset}}{PF} < \cos^{-1} PF$$

$$V_{S(LL)} = \sqrt{3} \times V_{S(LN)}$$

$$S_{S(1\emptyset)}=3V_{S(1\emptyset)}I_S^*$$

$$\%\eta=\frac{P_R}{P_S}\times 100\%$$

$$\%\,VR = \frac{|V_{R(NL)}| - |V_{R(FL)}|}{|V_{R(FL)}|} X\,100\%$$

$$V_{S(LN)} = AV_{R(LN)} + BI_{R(LN)}$$

Medium line

$$Z = R + jX$$

$$Y = (g + j\omega C)\ell$$

$$A = \left(1+\frac{ZY}{2}\right) \quad B = Z \quad C = Y\left(1+\frac{ZY}{4}\right) \quad D = \left(1+\frac{ZY}{2}\right)$$

$$\text{Connected load} = \frac{\text{diversity of group}}{\text{demand factor}} \times \text{maximum demand}$$

$$\text{load Factor} = \frac{\text{average load}}{\text{peak load}}$$

$$\text{Demand Factor} = \frac{\text{actual demand}}{\text{connected load}}$$

$$\text{Quantity in per unit} = \frac{\text{Actual Quantity}}{\text{Base value of quantity}}$$