KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2019

Mark scored:

Level : B.E.
Year : IV
Course : EPEG 417
Semester : II

Exam Roll No. :
Time: 30 mins.
F. M. : 10

Registration No.:
Date :

SECTION "A"
[20 Q × 0.5 = 10 marks]

Encircle the most appropriate answer.

1. FACTS devices are generally used to compensate.....of the transmission line.
   a. Reactance b. Resistance c. Conductance d. Admittance

2. Full form of UPFC is
   a. Unified power flow controller
   b. Unified power factor controller
   c. Unified power flow compensator
   d. Unique power flow controller

3. Assume a 275 kV transmission line having the following line constants: A = $0.8\angle 5°$; B = $200\angle 75°$. For obtaining 275 kV voltage at the receiving end obtaining unity power factor, the power angle required to be set as _____
   a. 24° b. 22° c. 25° d. 26.23°

4. Ferranti effect is not a problem for _____
   a. Long Transmission lines
   b. Medium Transmission lines
   c. Short Transmission lines
   d. Transmission line having high capacitance

5. Which of the following equipment is not used for voltage control?
   a. Tap changing Transformer
   b. Induction Generators
   c. Series Compensators
   d. Synchronous phase modifiers

6. What is the value of characteristics impedance for lossless transmission line?
   a. $\sqrt{(L/C)}$ b. $\sqrt{(R/C)}$ c. $\sqrt{(LC)}$ d. $\sqrt{(C/L)}$

7. A transmission line with Z= (2+j8) Ω has 10% of the voltage regulation with the lagging load of 0.8. If the load is 0.707 leading, the V.R. is _____ (Assume the current is same in both cases).
   a. -10% b. -8.63% c. -6.63% d. -5.77%

8. The two extreme values of the total fundamental component of reactive current drawn by a thyristor-controlled inductor are _____ and _____, respectively, where V_s is the supply voltage.
   a. $V_s(\omega L - 1/\omega C)$, $V_s\omega L$
   b. $V_s(\omega C - 1/\omega L)$, $V_s\omega L$
   c. $V_s(\omega C - 1/\omega L)$, $V_s\omega C$
   d. $V_s(\omega L - 1/\omega C)$, $V_s\omega C$

9. If a line is considered with negligible power losses, then the real power transmitted will be proportional to _____ and the reactive power drop is proportional to _____
   a. sinδ, voltage drop across line
   b. cosδ, voltage drop across line
   c. δ, voltage drop across line
   d. voltage drop across line, sinδ

10. STATCOM + SSSC will make
   a. UPFC
   b. UPQC
   c. TCSC
   d. SVR

11. In which region, TSC-TCR will compensate reactive power?
   a. Capacitive-Inductive
   b. Inductive only
   c. Capacitive only
   d. Resistive

12. STATCOM when equipped with a DC energy storage device of significant capacity can control
   a. Real power
   b. Reactive power
   b. No power sharing
   d. Both real and reactive power

13. The midpoint of the transmission line is the best location for the compensator because
   a. voltage swell is maximum at the midpoint
   b. reactance is low at the midpoint
   c. voltage sag is maximum at the midpoint
   d. reactance is high at the midpoint

14. Stability limit of the transmission line decreases with increase in
   a. Line length
   b. Line resistance
   c. Load
   d. None

15. Which device can compensate active power?
   a. STATCOM
   b. TCR
   c. GCSC
   d. TSSC

16. Synchronous Condenser is used to:
   a. Change line reactance
   b. Compensate real power
   c. Improve transient stability
   d. Compensate reactive power

17. Metal oxide varistor (MOV) is a part of
   a. TCVR
   b. TCPAR
   c. TCVL
   d. HVDC

18. Assume a 275 kV transmission line having the following line constants: $A = 0.8\angle 5°$; $B = 200\angle 75°$. If a load is connected at receiving end at unity power factor but maintaining the same voltage profile, then _____ compensation will be needed at _____.
   a. capacitive, receiving end
   b. inductive, sending end
   c. capacitive, sending end
   d. inductive, receiving end

19. Thermal capability of an overhead line is a function of the
   a. Wind conditions
   b. Line reactance
   c. Line capacitance
   d. Line admittance

20. The voltage at Bus A (reference) is 522 kV at an angle of -15 degrees. The voltage at Bus B is 518 kV at an angle of -18 degrees. Total impedance of the transmission path between the buses is 50 ohms. The real power flow is _____ MW from _____.
   a. 283MW, bus A to bus B
   b. 273MW, bus B to bus A
   c. 303MW, bus A to bus B
   d. 293MW, bus B to bus A

KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2019

Level	: B.E.	Course	: EPEG 417
Year	: IV	Semester	: II
Time	: 2 hrs. 30 mins.	F. M.	: 40

SECTION "B"
[5 Q × 8 = 40 marks]

Attempt *ANY FIVE* questions. Symbols have their usual meanings unless stated. Missing parameters can be assumed suitably.

1.

a. How is reactive power controlled in electrical network? State the objectives of FACTS controllers in the power system network and the main areas of application of FACTS devices? [3]

b. Write down the expression for equivalent impedance of a TCSC and state the condition on which TCSC operates on variable capacitive and variable inductive reactance mode. Draw the impedance vs. delay angle characteristics of TCSC indicating all modes of operation of TCSC. [5]

2.

a. Draw a legible figure to show the voltage behaviour of long transmission line indicating different loading condition and state what type of compensation is required for such loading conditions. [3]

b. Define the droop in V-I characteristic of SVC. Compare SVC and STATCOM based on their operating principle with their respective V-I characteristic. [5]

3.

a. Suppose you were to control TCSC, how would you implement bang-bang control? [3]

b. With phasor diagram explain the different modes of operation of UPFC. [5]

4.

a. What are the methods used for compensating the uncompensated transmission lines? State the configuration of compensation. Compare the conventional series controller with advanced series controller (IPFC). [5]

b. Explain how the voltage stability is improved using FACTS controllers. [3]

5.

a. An inductive load is supplied from a single-phase,230-V,50-Hz AC supply. The load current varies between the two extreme limits (4–j0) A and (6–j12) A. A thyristor-controlled inductor (TCI) is installed to compensate for the reactive power, thus making the power factor equal to unity. Find the values of L and C of the TCI. [5]

b. Discuss the advantages and limitations of Thyristor Controlled Voltage Regulators (TCVRs). [3]

6.

a. Suppose you were asked to compensate reactive power using STATCOM, how is reactive power generated or absorbed by STATCOM? Illustrate the control scheme for STATCOM and explain the function of each blocks. [6]

b. Bus A, the reference bus illustrated in Figure 1, has a voltage of 527 kV at an angle of -16 degrees. Bus B voltage is equal to 542 kV at an angle of -19 degrees. Load 1 has a power factor of 0.93, while load 2 has a power factor of 0.82. If the total impedance of the transmission path is 75 ohms, find (a) the real power flow, (b) the direction of real power flow, (c) the reactive power flow, and (d) the direction of reactive power flow. [2]

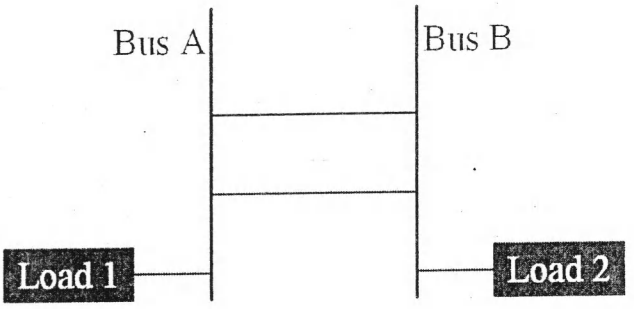

Figure 1