

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), April-May 2016

B. Tech in EE Engineering, Semester VI

Roll No.....

EE621: POWER SYSTEM TRANSIENTS

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. The voltage measurements using uniform spark gap are affected by
 - (a) Nearby earthed objects
 - (b) Polarity of supply
 - (c) Dust particles
 - (d) All of the above
- ii. An overhead line with surge impedance 400 ohms is terminated through a resistance R. A surge travelling over the line does not suffer any reflection at the junction if the value of R is
 - (a) 20 Ω
 - (b) 200 Ω
 - (c) 800 Ω
 - (d) None
- iii. Steepness of the traveling waves is attenuated by
 - (a) Resistance of the line
 - (b) Inductance of the line
 - (c) Capacitance of the line
 - (d) All of the above
- iv. Switching surges are
 - (a) High voltage DC
 - (b) High voltage AC
 - (c) Short duration transient voltage
 - (d) Hyperbolically dying voltage
- v. The velocity of a travelling wave through a cable of relative permittivity 9 is:
 - (a) 9×10^8 m/sec
 - (b) 3×10^8 m/sec
 - (c) 108 m/sec
 - (d) 2×10^8 m/sec
- vi. For reducing tower footing resistance it is better to use
 - (a) Chemical and ground rods only
 - (b) Chemical and counterpoise only
 - (c) Ground rod and counterpoise only
 - (d) Chemical, ground rods and counterpoise
- vii. The impulse ratio for any particular object
 - (a) Constant
 - (b) Depends upon the shape of a wave
 - (c) (b) and (c)
 - (d) Depends upon the polarity of the impulse wave



- viii. Impulse voltages are characterized by
- (a) Polarity
 - (b) Peak value
 - (c) Time of half the peak value
 - (d) all of the above.
- ix. Traveling wave gets reflected from an open circuited line with reflected current wave of _____ polarity and voltage wave of the _____ polarity
- (a) Opposite, Same
 - (b) Same, Same
 - (c) Same, Opposite
 - (d) None
- x. A potential divider is normally connected
- (a) Outside the generator circuit towards the load circuit
 - (b) Within the generator circuit
 - (c) At a distance $V/100$ meters from the generator where V is the voltage to be measured in KV
 - (d) None of the above

Q.2 Short answer type questions (4 questions @ 2.5 marks) 10

- i. How does a surge occur during switching?
- ii. State the parameters and the characteristics of the lightning strokes.
- iii. State the importance of transient study in planning.
- iv. Explain the adverse effect of back flashover.

Q.3A What is arcing ground? Explain its effect on the performance of a power system. 05

Q.3B Discuss Simpson's and Scars theory for the charges formation of a thundercloud. 05

Q.4A What is capacitance switching? Explain its effect on the performance of the circuit breaker. 05

Q.4B Explain Bewley's lattice diagrams with examples. 05

Q.5A Derive expression for attenuation and distortion of electromagnetic waves in respect of transmission line. 05

Q.5B Write short note about stepped leader and pilot streamer. 05

Q.6A Derive an expression for reflection and refraction of travelling waves for transmission line is terminated with a load impedance Z_L . Take characteristic impedance of line Z_0 . 05

Q.6B A 1 MVAR capacitor bank is connected to 11 KV Substation for power factor compensation. The short-circuit level and short-circuit current of the substation are 110 MVA and 3.15-kA rms respectively. Determination of the frequency of the transient voltage across circuit breaker associated with capacitor bank. Let assume supply frequency 60Hz and supply side capacitance C_s 10 nF. 05

OR

Q.6B What is a travelling wave? Explain the development of such a wave on an overhead 05

line. •

Q.7A What is tower-footing resistance? Why is it required to have this resistance as low as economically feasible? 05

Q.7B Explain the principle of operation of the surge absorber 05

OR

Q.7B At 50 Hz, 11 KV, 3-phase alternator with earthed neutral has a reactance of 20 ohms per phase and is connected to a bus-bar through a circuit breaker. The distributed capacitance up to circuit breaker between phase and neutral is $0.01 \mu\text{F}$. Determine

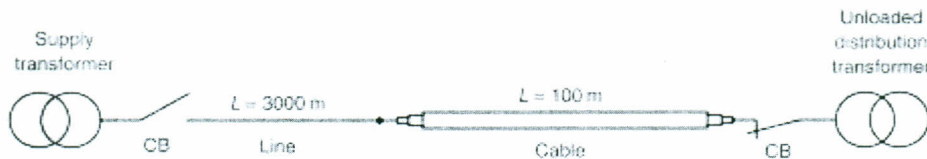
(i) Peak re-striking voltage across the contacts of the breaker

(ii) Frequency of oscillations

(iii) The average rate of rise of re-striking voltage up to the first peak

Q.8 What are the requirements of a ground wire for protecting power conductors against direct lightning stroke? Explain how they are achieved in practice. 10

Q.9A Draw Lattice diagrams by considering following parameters for below circuit. 10



Overhead line: Characteristic impedance $Z_{\text{line}} = 100 \Omega$

Propagation velocity of the electromagnetic waves

$v_{\text{line}} = 600\,000 \text{ km/s}$

Travel time $\tau_{\text{line}} = 40 \mu\text{s}$

Cable Characteristic impedance $Z_{\text{cable}} = 10 \Omega$

Q.9B Explain in detail how EMTP is used for the computation of Transients in power system. 10

OR

Q.9B Describe the construction, principle of operation and application of 10

- (i) Rod gaps
- (ii) Expulsion gap

