Total No. of Questions: 6 *Total No. of Printed Pages:2*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2019

EE3EL07 / EX3EL07 Power Quality and System Reliability

Programme: B.Tech. Branch/Specialisation: EE/EX

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. Voltage sag is mainly caused by short circuit fault **1**
(a) True (b) False
(c) Induction motor starting (d) None of these

ii. During a single line to ground fault, the IUF is **1**
(a) 0.0 (b) 0.5 (c) 0.75 (d) 1.0

iii. A simple single level inverter contains in output voltage **1**
(a) No harmonics (b) Only triple harmonics
(c) Even harmonics (d) Only odd harmonics

iv. RMS voltage across and current drawn by a non linear load are 300 V and 5 A. Wattmeter reads 1.0 kW. The displacement power factor is **1**
(a) 0.5 (b) 0.67 (c) 0.9 (d) Cannot say

v. Which of the following expression is correct? **1**
(a) $R(t) = P[T > t]$ (b) $R(t) = \lambda e^{-\lambda t}$
(c) $H(t) = -f(t)/R(t)$ (d) $R(t) = F(t) - 1$

vi. Usually failure rate of component is given as **1**
(a) 1/MTTF (b) 1/MTBF (c) 1/MTTR (d) None of these

vii. FOR is expressed as **1**
(a) λ/μ (b) $1/\lambda$ (c) $1/\mu$ (d) $\mu/(\lambda+\mu)$

viii. LOLE gives idea regarding **1**
(a) Time for which load exceeds the generating capacity
(b) Time for which capacity exceeds the load on the plant
(c) Average load supplied
(d) None of these

P.T.O.

ix. Which one of the following is customer-based index? **1**
(a) Average interruption duration
(b) Average interruption duration per year
(c) Failure rate at load point
(d) CAIDI

x. Which of the following is basic reliability index? **1**
(a) SAIFI (b) SAIDI
(c) CAIDI (d) Annual outage time

Q.2 i. Define PVUR and LVUR. **2**
ii. Explain Oscillatory transients due to capacitor switching. **8**
OR iii. Discuss various methods for mitigating voltage sag. **8**

Q.3 i. Explain voltage v/s current harmonics. **4**
ii. Explain displacement and true power factor in presence of harmonics. **6**
OR iii. Explain operation of TCR and derive expression for susceptance. **6**

Q.4 i. Define reliability function. **2**
ii. Explain exponential failure density function. **3**
iii. Derive expression for availability function of a repairable component. **5**
OR iv. Explain reliability evaluation of series and parallel system. **5**

Q.5 i. Define LOLP and LOLE. **3**
ii. Explain effect of scheduled maintenance on LOLP calculation. **7**
OR iii. A power plant has three generators each of capacity 150 MW and availability 0.95. Load duration curve is straight line with peak load 250 MW. Load factor of the plant is 0.5. Calculate LOLP. **7**

Q.6 i. Enlist measures for reliability improvement of distribution systems. **4**
ii. Explain basic reliability indices of a radial distribution system. **6**
OR iii. Discuss SAIFI, CAIDI and SAIDI indices for distribution system. **6**

******

Marking Scheme

EE3EL07 / EX3EL07 Power Quality and System Reliability

Q.1	i.	Voltage sag is mainly caused by short circuit fault (c) Induction motor starting		**1**
	ii.	During a single line to ground fault, the IUF is (d) 1.0		**1**
	iii.	A simple single level inverter contains in output voltage (d) Only odd harmonics		**1**
	iv.	RMS voltage across and current drawn by a non linear load are 300 V and 5 A. Wattmeter reads 1.0 kW. The displacement power factor is (d) Cannot say		**1**
	v.	Which of the following expression is correct? (a) R(t) = P[T > t]		**1**
	vi.	Usually failure rate of component is given as (a) 1/MTTF		**1**
	vii.	FOR is expressed as (a) λ/μ		**1**
	viii.	LOLE gives idea regarding (a) Time for which load exceeds the generating capacity		**1**
	ix.	Which one of the following is customer-based index? (d) CAIDI		**1**
	x.	Which of the following is basic reliability index? (d) Annual outage time		**1**
Q.2	i.	Definition of PVUR	1 mark	**2**
		Definition of LVUR	1 mark	
	ii.	Oscillatory transients due to capacitor switching		**8**
		Explanation	2 marks	
		Frequency	3 marks	
		Magnitude	3 marks	
OR	iii.	Methods for mitigating voltage sag		**8**
		Enlisting of methods	4 marks	
		Explanation	4 marks	
Q.3	i.	Voltage harmonics	2 marks	**4**
		Current harmonics	2 marks	
	ii.	Displacement power factor	3 marks	**6**
		True power factor	3 marks	
OR	iii.	Operation of TCR	3 marks	**6**
		Derivation of expression for susceptance	3 marks	
Q.4	i.	Definition of reliability function.		**2**
	ii.	Exponential failure density function		**3**
		Expression	1 mark	
		Explanation	2 marks	
	iii.	Availability function of a repairable component		**5**
		State diagram	2 marks	
		Derivation	3 marks	
OR	iv.	Reliability evaluation of series system	2 marks	**5**
		Parallel system	3 marks	
Q.5	i.	LOLP	2 marks	**3**
		LOLE	1 mark	
	ii.	Effect of scheduled maintenance on LOLP calculation		**7**
		Modification of LDC	3 marks	
		Explanation	4 marks	
OR	iii.	Calculate LOLP.		**7**
		LDC	2 marks	
		LOLP formula	3 marks	
		Calculation	2 marks	
Q.6	i.	Measures for reliability improvement of distribution systems.		**4**
		Fault avoidance	2 marks	
		Fault tolerant	2 marks	
	ii.	Basic reliability indices of a radial distribution system		**6**
		System failure rate	2 marks	
		Annual outage duration	2 marks	
		Average interruption duration	2 marks	
OR	iii.	SAIFI, CAIDI and SAIDI indices for distribution system.		**6**
		2 marks for each	(2 marks *3)	

******