Q.4	i.	Define voltage regulation of a transmission line. How voltage regulation vary according to the load power factor?	**3**
	ii.	What do you understand by Ferranti effect? How this effect depends on system frequency?	**7**
OR	iii.	A single phase 60 Hz generator supplies an inductive load of 4500 kW at a power factor of 0.80 lagging by means of an 20 km long O.H transmission line. The line resistance and inductance are 0.0195 ohm and 0.60 mH per km. The voltage at the receiving end is required to be kept constant at 10.2 kV. Calculate the sending end voltage and voltage regulation of the line.	**7**
Q.5	i.	Explain Kelvin's law for determination of conductor size. Give its practical limitations.	**4**
	ii.	Compare the conductor material (volume) for 3-phase, 4-wire distribution with that of 2-wire, D C distribution system. State assumption made.	**6**
OR	iii.	A 2-conductor cable 1 km long is required to supply a constant current of 200 A throughout the year. The cost of cable including installation is Rs. (20 a + 20) per metre where 'a' is the area of X-section of the conductor in cm2. The cost of energy is Rs. 0.05 per kWh and interest and depreciation charges amount to 10%. Calculate the most economical conductor size. Assume resistivity of conductor material to be 1•73 μ Ω cm.	**6**
Q.6		Attempt any two:	
	i.	A 3-phase transmission line is being supported by three disc insulators. The voltage across top unit and middle unit are 8 and 11 KV, respectively. Calculate the line voltage and string efficiency.	**5**
	ii.	Explain briefly the capacitance grading method of cables.	**5**
	iii.	State the classification of cables according to voltage and discuss their general construction.	**5**

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Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering

End Sem (Even) Examination May-2019

EE3CO11/EX3CO11 Power System-I

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.	Which of the following is a advantage of Interconnection of generating stations? (a) Increased reliability (b) Economical operation (c) Use of old plants (d) All of these	**1**
	ii.	An capacitor across the load can improve power factor in case (a) Load is capacitive (b) Load is inductive (c) Load is resistive (d) All of these	**1**
	iii.	What is the value of charging current in short transmission lines? (a) Less than medium transmission lines (b) Equal to medium transmission lines (c) More than medium transmission lines (d) More than long transmission lines	**1**
	iv.	Value of Inductive reactance in short transmission lines is: (a) More at receiving end (b) More at sending end (c) Uniformly distributed over entire length (d) More in middle of sending end and receiving end	**1**
	v.	Regulation of short transmission lines depends: (a) Only on line resistance (b) Only on line inductance (c) Only on line capacitance (d) On line inductance and line resistance	**1**

vi. What is the percentage voltage regulation of short transmission line if its sending end and receiving end voltages are 160 kV and 132 kV respectively? **1**

(a) 30 % (b) 21.21 % (c) 12.12 % (d) 38.22 %

vii. Which of the following is not a part of distribution system? **1**

(a) Feeder (b) Distribution

(c) Generating station (d) Service mains

viii. The most economical area of conductor is that for which total annual cost of line is minimum. Which law states this? **1**

(a) Lenz's law (b) Kelvin's law

(c) Faraday's law (d) Ohm's law

ix. Which of the following is a requirement of the insulating material used for cable? **1**

(a) High insulation resistance

(b) High dielectric strength

(c) Good tenacity and elasticity

(d) All of these

x. Which of the following is a method of equalising the potential across string of insulators? **1**

(a) Kelvin's law (b) Static shielding (guard ring)

(c) Resistance grounding (c) None of these

Q.2 i. What information will you get from a load curve of a typical generating station? **2**

ii. Define the following terms: **3**

(a) Maximum demand (b) Demand factor, and

(c) Load factor.

iii. What do you understand by depreciation? Explain methods used to calculate depreciation. **5**

OR iv. A power station supplies the following load **5**

Time (hours)	Load (MW)
6 AM — 8 AM	1.2
8 AM — 9 AM	2.0
9 AM — 12 Noon	3.0

12 Noon — 2 PM	1.50
2 PM — 6 PM	2.50
6 PM — 8 PM	1.80
8 PM — 9 PM	2.0
9 PM — 11 PM	1.0
11 PM — 5 AM	0.50
5 AM — 6 AM	0.80

(a) Plot the load curve and find out the load factor.

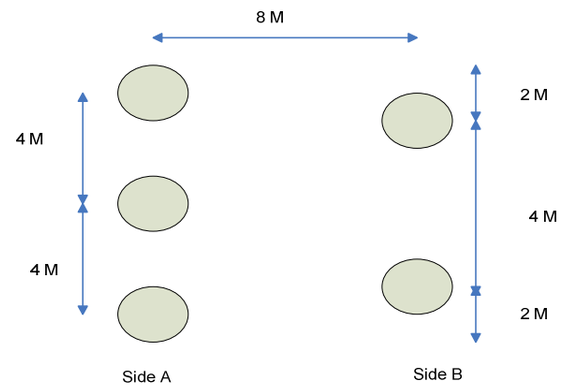
(b) Determine the proper number and size of generating units to supply this load.

(c) Find the reserve capacity of the plant and capacity factor.

Q.3 i. What do you understand by the constants of an overhead transmission line? **2**

ii. Derive an expression for inductance of a 3-phase O.H transmission line with unsymmetrical spacing between the line conductors. **8**

OR iii. The arrangement of conductor of a single phase transmission line is shown in figure below, wherein the forward circuit is composed of three solid wires of 2.5 mm in radii and return circuit of two wires of radii of 5 mm placed symmetrically with respect to the forward circuit. Calculate the inductance of each side of the line and that of the complete line. **8**



EE 3 Coll

Power System - I

Q 1 MCQ

(i) (d) All of these

(ii) (b) Load is inductive.

(iii) (a) Less than medium transmission line

(iv) (c) Uniformly distributed over entire length

(v) (d) on line inductance and line resistance

(vi) (b) 21.21 %,

(vii) ~~(b) Kelvin's law~~ (c) Generating station.

(viii) (b) Kelvin's Law

(ix) (d) All of these

(x) (b) static shielding Guarding.

———— X ————

Q2 (i) Max demand/Min demand 1
Energy Generated 1 2

(ii) 1 marks each for definition 3

(iii) Depreciation 2
Methods 3

or.

Plot and load factor (.525) 2

(b) Size 3×1.25 — 1
$= 3.75$ MW ~ 2 units each of 2 MW

(c) Capacity factor — 1
Rated Capacity — 1.25 MW 1

Capacity factor = $\frac{\text{Avg load}}{\text{Rated plant capacity}}$

$= \frac{1.575}{4}$

$= 0.39375$ 1

Q3 (i) Explanation — 2

(ii) Derivation — 8

or (iii) $L_A = 2 \times 10^{-7} \ln \frac{D_a}{D_s}$ 4

Calculation $= 2 \times 10^{-7} \ln \frac{9.205}{1.94}$ H/M

$= 3.11 \times 10^{-7}$ H/M

$L_B = 2 \times 10^{-7} \ln \frac{9.205}{.078}$ H/M

$= 9.54 \times 10^{-7}$ H/M

Q4 (i) Definition - 1
Variation - 2

(ii) Ferranti effect - 5
Effect of freq - 3

Or (iii) sending end voltage - 4
Voltage Regulation - 3
V_S = ~~12.66 kV~~ 10.71
% R = 2.57.

Q5 (i) Kelvin law - 3
limitati - 1

(ii) Comparison - 4
Assumption - 2

(iii) Formula - 3
Solution - 3
a = 1.74 cm

Q6 (i) Line voltage = 64.26 kV (rms) - (3)
η% = 88.28 - (2)

(ii) Explain grading -
Capacitance grading - 4
Explanation - 2

(iii) Classification - 2
Gen constration - 3

Q. 5 (iii)

Resistance of one conductor $= \frac{\rho l}{a}$

$= \frac{1.73 \times 10^{-6}}{a} \times 10^5 = \frac{0.173}{a}\ \Omega$

Energy lost/annum =

$\frac{2 I^2 R t}{1000}$ kWh

$= \frac{2(200)^2 \times 0.173 \times 8760}{1000 \times a} = \frac{12123.4}{a}$ kWh

Annual cost of energy lost =

cost per kWh × Annual energy loss.

$= Rs\ \frac{5}{100} \times \frac{12123.4}{a}$

$= Rs\ 6062/a.$

For 1 km length,
The capital cost = Rs. $(20 \times 1000)a$
$= Rs, 20,000a.$

Annual variable charg = $0.1 \times 20,000a$,
$= Rs\ 2000a.$

As per Kelvin's law
most economical × Section of cond.
VAC = Annual cost of energy cost

$2000a = 6062/a$

$a = \sqrt{\frac{6062}{2000}} = 1.74$ cm²