

**BITS, PILANI – DUBAI CAMPUS,
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
SECOND SEMESTER 2013 – 2014
EEE F312 POWER SYSTEMS
COMPREHENSIVE EXAMINATION (CLOSED BOOK)**

**MAXIMUM MARKS: 40
DATE: 29/05/14**

**WEIGHTAGE: 40%
DURATION: 3 HOURS**

1. The annual load duration curve of a certain power station shown in Figure 1 can be considered as a straight line from 20 MW to 4 MW. To meet this load, three-turbine generating units, two rated at 10 MW each and one rated at 5 MW are installed. Estimate
- Installed capacity.
 - Plant factor, Load factor and utilization factor.
 - Units generated per annum.
- [6 Marks]**

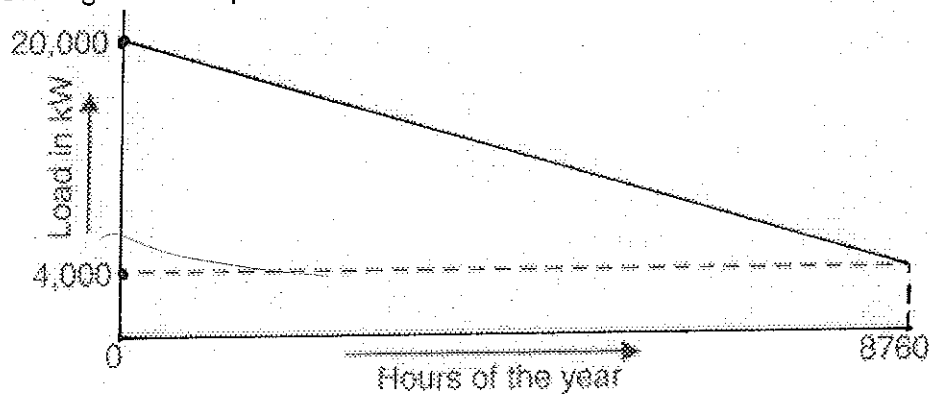


Figure 1

2. Derive the capacitance of a completely transposed three-phase line with unsymmetrical spacing. **[4 Marks]**
3. A 3 phase, 50 Hz, 16 Km long overhead transmission line supplies 1000 kW, at 11kV, 0.8 power factor lagging. The line resistance is 0.03Ω per phase per Km and line inductance is 0.7 mH per phase per Km. Calculate (a) Sending end voltage per phase (b) Voltage Regulation. **[5 Marks]**
4. Obtain the Y-bus matrix for the 3-node admittance network as shown in the Figure 2. **[5 Marks]**

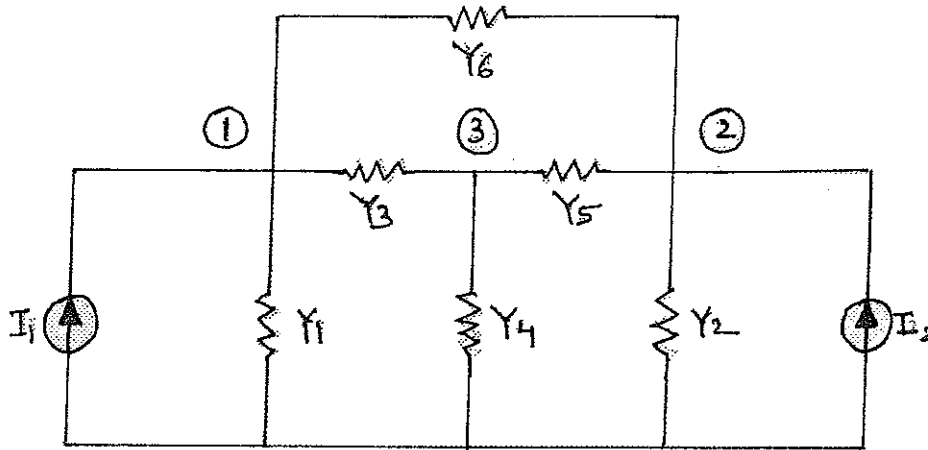


Figure 2

5. In a power generating station with two plants, the incremental fuel costs are given by

$$\frac{dC_1}{dP_{G1}} = 0.01P_{G1} + 20 \text{ Rs / MWh}$$

$$\frac{dC_2}{dP_{G2}} = 0.015P_{G2} + 22.5 \text{ Rs / MWh}$$

The system is running with optimal schedule with $P_{G1} = P_{G2} = 100 \text{ MW}$.

If $\frac{\partial P_L}{\partial P_{G2}} = 0.2$, find the plant penalty factors and $\frac{\partial P_L}{\partial P_{G1}}$ [5 Marks]

6. The voltage at the terminals of a balanced load consisting of three 20Ω , Y-connected resistors are : $V_{an} = 200 e^{j0}$, $V_{bn} = 100 e^{j255.5}$, $V_{cn} = 200 e^{j151}$ volts, where angles are given in degrees. Find the power (in watts) expended in the 20Ω resistors, applying theory of symmetrical components. [5 Marks]

7. From the fundamentals derive the expression for "SWING –EQUATION" with respect to power system stability. [5 Marks]

8. Write short notes on:
(a) Over current relays
(b) Current Transformers.

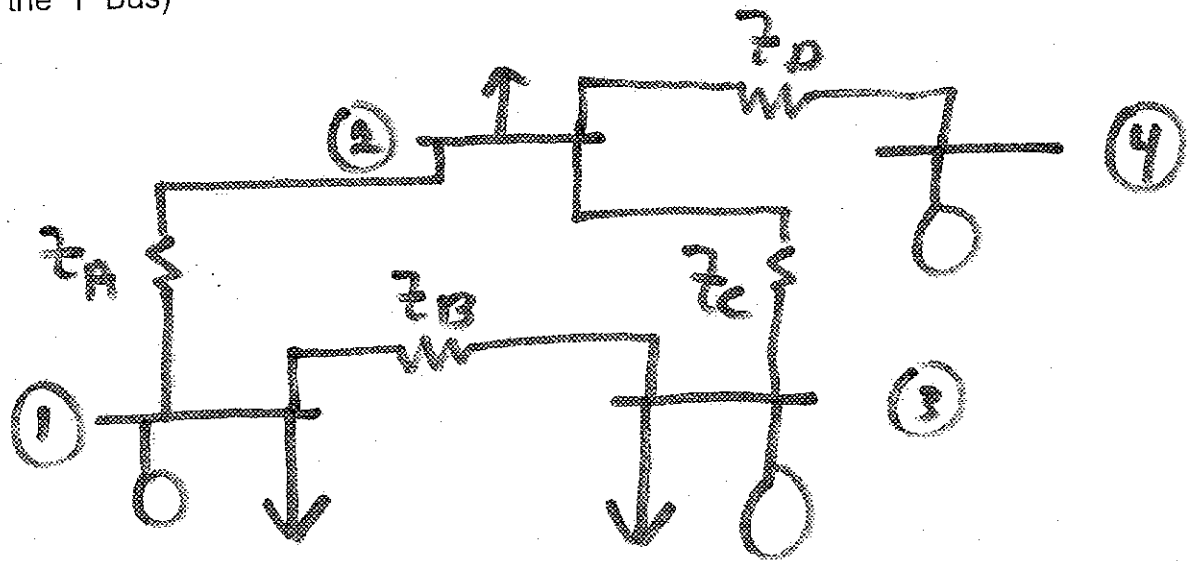
[5 Marks]

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TEST 2 (OPEN BOOK)

MAXIMUM MARKS: 20
DATE: 21/04/14

WEIGHTAGE: 20%
DURATION: 50 MINUTES

1. Determine the bus admittance matrix for the network shown in Figure 1, assuming the current injection in each bus 'i' is $I_i = I_{Gi} - I_{Di}$ where I_{Gi} is the current injection into the bus from the generator and I_{Di} is the current flowing into the load. (Note: KCL equations at each bus has to be shown in deriving the 'Y' Bus)



[6 Marks]

Figure 1

2. The fuel costs of two generating units (PG_1 , PG_2) in a power system are given by
 $C_1 = 1.5 + 20 PG_1 + 0.1 PG_1^2$ Rs/h
 $C_2 = 1.9 + 30 PG_2 + 0.1 PG_2^2$ Rs/h
 PG_1 , PG_2 are in MW. Find the optimal schedule of the generators neglecting losses, when the demand is 200 MW. Also find the value of ' λ '. [6 Marks]
3. A single-phase resistive load of 100KVA is connected across lines 'bc' of a star connected balanced three phase supply of 3 kV. Compute the symmetrical components of line currents. Assume positive phase sequence. [8 Marks]

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TEST 1 (CLOSED BOOK)**

**MAXIMUM MARKS: 25
DATE: 03/03/14**

**WEIGHTAGE: 25%
DURATION: 50 MINUTES**

1. A power plant has got the following annual factors: Load factor = 0.75, plant capacity factor = 0.6, plant use factor = 0.65. Maximum demand = 60 MW. Estimate
 - a) The annual energy production.
 - b) Installed and Reserve capacity of the plant.
 - c) The hours during which the plant is not in service per year. **[9 Marks]**

2. (a) Derive the inductance of a completely transposed three-phase line with unsymmetrical spacing. **[5 Marks]**

(b) A three phase 50 Hz transmission line has a flat horizontal spacing with 4 m between adjacent conductors. The diameters of each conductor are 1 cm and line voltage is 100 KV. Find the capacitance to neutral and the charging current per kilometer of the line. **[6 Marks]**

3. Derive the ABCD parameters for a medium transmission line. (Use nominal 'T' network for derivation). **[5 Marks]**

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QUIZ 2 (CLOSED BOOK)

MAXIMUM MARKS: 7
DATE: 05.05.14

WEIGHTAGE: 7 %
DURATION: 20 MINUTES

NAME:

Id. No.:

1. The sequence network diagram of a Line-to-Line fault involves a zero-sequence network. _____ (TRUE/ FALSE) [1M]
2. Draw the sequence network for a single line to ground fault with complete labelling. [2M]

3. Write down the expression for "M" (Moment of Inertia) in connection to dynamics of Synchronous machine and mention its unit. [1M]

4. Draw the equivalent "Pe- δ " diagram with complete labeling in connection with Equal Area Criterion in power system stability [2 M]

5. Prove that , $\frac{1}{\alpha} = \alpha^*$ where $\alpha = e^{j120}$ [1M]

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QUIZ 1 (CLOSED BOOK)

MAXIMUM MARKS: 8
DATE: 24.03.14

SET 2

WEIGHTAGE: 8 %
DURATION: 20 MINUTES

NAME:

Id. No.:

1. If the receiving end voltage is greater than the sending end voltage, regulation of transmission line will be [1M]

- (a) Positive (b) Negative
(c) Zero (d) None of the above

2. A load curve is a plot of

- (a) Load versus generation capacity (b) Load versus current
(c) Load versus time (d) Load versus cost of power. [1M]

3. If we increase the length of the transmission line, the charging current of the line will _____ [1M]

- (a) Increase (b) Decrease
(c) Not affected (d) none of the above

4. In a system if the base load is the same as the maximum demand, the load factor will be:

- (A) 1 (B) Zero
(C) Infinity (D) 1 percent.

[1M]

5. The fictitious radius for the inductance calculation for a conductor with radius ' r ' is given by the expression _____ [1M]
6. The unit of parameter " C " in medium transmission line (" T " model) is _____ [1M]
7. An infinitely long straight conductor carries a uniform charge of ' q ' coulomb per meter length. If ' k ' is the permittivity of the medium wherein two points are located at distance D_1 and D_2 respectively from the conductor axis. The potential difference V_{12} (between the two points) is given by _____ [2 M]