

**BITS, PILANI – DUBAI CAMPUS**  
**Knowledge Village, Dubai**

**Semester II 2005 – 2006**  
**IV Year (EEE)-Elective**

**COMPREHENSIVE EXAMINATION (Closed Book)**

**Course No.:** EEE UC 462

**Course Title:** Advanced Power Systems

**Date:** 25.05.2006

**Time:** 3 Hours

**M.M. = 40 (40 %)**

Q.4. Derive an expression for the fault current using symmetrical component method for single line to ground fault. [3]

Three impedances of  $(5 - j10)$ ,  $(6 + j5)$  and  $(3 + j15)$  ohms are connected in star to red, yellow and blue lines of a 3300 V, 3-phase, 3-wire supply.

The phase sequence is RYB. Calculate the line current  $I_R$ . [4]

- Q.5. a. What is a circuit breaker? Discuss Arc phenomenon in CB's.  
b. What is protective relay? Explain its function in an electrical system.  
c. What are the advantages and disadvantages of SF6 CB?  
d. Draw the circuit diagram of a Zig zag transformer for neutral grounding.

[8]

Q.6. Derive Swing equation.

A 50Hz, 4 pole alternator rated 100MVA, 11kV has an inertia constant of 8 MJ/MVA. Find the stored energy in the rotor at synchronous speed. If the mechanical input is suddenly raised to 80 MW for an electrical load of 50MW, find rotor acceleration, neglecting mechanical and electrical losses. [4+4]

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*Please note:*

- 1. Attempt all questions, preferably in serial order.*
- 2. All the symbols used, carry their usual meanings.*
- 3. Assume suitable data, if needed.*

Q1. Compare the thermal and hydro electric power plants on the basis of operating cost, initial cost, efficiency, maintenance cost and availability of source of power. [5]

Q.2. What is the importance of high load factor? [2]

The load duration curve for a typical heavy load being served by a combined hydro-thermal system may be approximated by a straight line; maximum and minimum loads being 60,000kW and 20,000 kW respectively. The hydro power available at the time of minimum regulated flow is just sufficient to take a peak load of 50,000 kWh per day. It is observed that it will be economical to pump water from tail race to the reservoir by utilizing the thermal power plant during the off peak periods and thus running the station at 100 % load factor. Determine the maximum capacity of each type of plant. Assume efficiency of steam conversion to be 60 %. [4]

Q.3. Prove for the medium transmission lines, using T-model,  $AD - BC = 1$ .

Find the following for a single circuit transmission line delivering a load of 50 MVA at 110 kV and p.f. 0.8 lagging:

- Sending end voltage and current
- Sending end power and efficiency of transmission.

Given:  $A = D = 0.98 \angle 3^\circ$ ;  $B = 110 \angle 75^\circ \Omega$ ;  $C = 0.0005 \angle 80^\circ$  siemen.

[2+4]

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**Test 2 (Open Book)**

Course No.: EEE UC 462

Course Title: Advanced Power Systems

Date: 04.05.2006

Time: 50Minutes

M.M. = 20 (20 %)

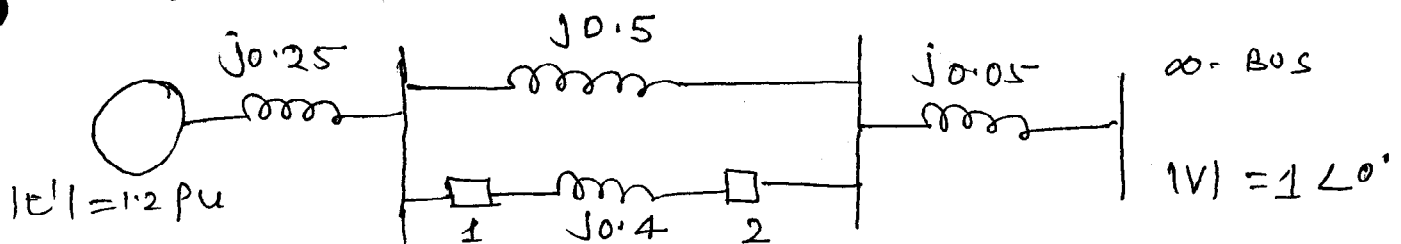
Only Text Book and Notes are allowed.

Attempt all questions.

Q1. A station operating at 33kV is divided into sections A and B. Section A consists of three generators 15MVA each having reactance of 15% and section B is fed from the grid through a 75 MVA transformer of 8% reactance. The circuit breakers have each a rupturing capacity of 750MVA. Determine the reactance of the reactor to prevent the breakers being overloaded if a symmetrical short circuit occurs on an outgoing feeder connected to A. [6]

Q2. The L-G voltage on the HV side of a step up transformer are 100, 33 and 38 kV respectively on phases a, b and c. The voltage of phase a leads that of phase b by 100 degrees and lags that of phase c by 176.5 degrees. Determine the symmetrical components of the voltages. [4]

Q3. Given below, the sub system where a three phase fault is applied at the point M. Find the critical clearing angle for clearing the fault with simultaneous opening of the breaker 1 and 2. The reactance values are indicated on the diagram. [6]



Q4. A 3 phase, 3 wire system has a normal voltage of 10.4kV between the lines. It is supplied by a generator having positive, Negative and Zero sequence reactance of 0.6, 0.5 and 0.2 ohm per phase respectively. Calculate the fault current which flows when a L-L fault occurs at the generator terminals. [4]

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Knowledge Village, Dubai

Semester II 2005 – 2006

IV Year (EEE)-Elective

Test 1 (Closed Book)

Course No.: EEE UC 462

Course Title: Advanced Power Systems

Date: 02.04.2006

Time: 50Minutes

M.M. = 20 (20 %)

- *Attempt all questions in serial order.*
- *Please don't use shortcuts.*
- *Assume suitable data, if missing.*

Q.1. A power station has the following daily load cycle:

Time (hrs)	6-8	8-12	12-16	16-20	20-24	24-6
Load (MW)	20	40	60	20	50	20

Plot the load curve and load duration curve.

(3 + 2)

Q.2. An electric supply company having a maximum load of 50MW generates  $18 \times 10^7$  units/Annum and the supply consumers have an aggregate demand of 75 MW. The Annual expenses including capital charges are:

For fuel : Rs 90 lakhs

Fixed charge concerning generation = Rs 28 lakhs

Fixed charges concerning T & D = Rs 32 lakhs

Assuming 90 % of the fuel cost is essential to running charges and the loss in T & D as 15 % of units generated. Deduce a two part tariff to find the annual cost of supply to the consumers.

(5)

Q.3. Show that the disc nearest to the conductor has maximum voltage across it, in case of an insulator string. (Consider 3 disc string and assume  $k = 0.2$ )

(5)

Q.4. Deduce expressions to calculate sag in OH Lines when they are supported at equal level and at unequal levels.

(2 + 3)

OR

Q.4'. A balanced 3 phase load of 30 MW is supplied at 132 kV, 50 Hz and 0.85 pf lagging by means of a transmission line. The series impedance of a single conductor is  $(20 + j2)$  ohms and the total phase-neutral admittance is  $315 \times 10^{-6}$  siemens. Using nominal T method, determine the A, B, C, D constants and the sending end voltage.

(3 + 2)

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**Semester II 2005 – 2006**  
**IV Year (EEE)-Elective**

**Test 1 (Closed Book)**

**Course No.:** EEE UC 462

**Course Title:** Advanced Power Systems

**Date:** 10.04.2006

**Time:** 50Minutes

**M.M. = 20 (20 %)**

*Make up test*

- *Attempt all questions.*

- Q1. Load factor of a consumer is 35% and monthly consumption is 504 kWh. If the rate of Electricity is Rs 180 per KW of maximum demand plus Rs 2.00 per kWh, find the monthly bill and average cost per kWh. If the consumption is increased by 20% with the same load factor, find the overall cost per kWh. [5]
- Q2. Represent Transmission line in terms of ABCD parameters and then prove  $AD - BC = 1$ . [5]
- Q3. A 3 phase, 50 Hz, 220 kV transmission line consists of conductors of 2 Cm diameter and spaced equilaterally at a distance of 4 m. the line conductors have smooth surface with value of  $m = 0.96$ . The barometric pressure is 73 Cm of Hg and temperature of 20 degree centigrade. Determine the corona loss. [5]
- Q4. A 3 phase transmission line is being supported by three disc insulators. The potential across top unit (near to tower) and middle unit are 8 kV and 11kV respectively. Calculate the ratio of capacitance between pin and earth to the self capacitance of each unit and also the line voltage. [5]

Name:

Id:

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**Semester II 2005 - 2006**  
**IV Year (EEE)-Elective**

**QUIZ (Closed Book)**

Course No.: EEE UC 462

Course Title: Advanced Power Systems

Date: 09.03.2006

Time: 30 Minutes

M.M. = 20 (10 %)

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*Tick the correct Answer.*

1. The most economic load on an OH transmission line
  - a. Greater than the natural load
  - b. Less than the natural load
  - c. Equal to the natural load
  - d. None of the above is necessary
  
2. For a long transmission line, for a particular receiving end voltage, when sending end voltage is calculated, it is more than the actual value when calculated by
  - a. Load end capacitance model
  - b. Nominal Pi Model
  - c. Nominal T-Model
  - d. None of the above
  
3. The p.u. impedance value of an alternator corresponding to base values 13.2 kV and 30 MVA is 0.2 p.u. the p.u. value for the base values 13.8 kV and 50 MVA will be
  - a. 0.306 p.u

- b. 0.33 p.u.
  - c. 0.318 p.u
  - d. 0.328 p.u
4. For a lumped inductive load, with increase in supply frequency
- a. P and Q increase
  - b. P increase, Q decrease
  - c. P decrease, Q increase
  - d. P and Q decrease
5. Ferranti effect on long OH lines is experienced when it is
- a. lightly loaded
  - b. on full load at unity p.f
  - c. on full load at 0.8 p.f lag
  - d. in all the above cases
6. Effect of increase in temperature in OH transmission lines is to
- a. Increase the stress and length
  - b. Decrease the stress and length
  - c. Decrease the stress but increase the length
  - d. None of the above
7. Stringing chart is useful for
- a. Finding the sag in the conductor
  - b. In the design of the tower
  - c. In the design of the insulator string
  - d. Finding the distance between the tower
8. The presence of earth in case of OH transmission line
- a. Increases the capacitance
  - b. Increases the inductance

- c. Decreases the capacitance
  - d. Decreases the inductance
9. Corona loss is less when the shape of the conductor is
- a. Circular
  - b. Flat
  - c. Oval
  - d. Independent of the Shape
10. The corona loss on a particular system at 50 Hz is 1kW/phase/km. the coronal loss on the same system with supply frequency 25 Hz will be
- a. 1 kW/phase/km
  - b. 0.5 kW/phase/km
  - c. 0.667 kW/phase/km
  - d. None of the above
11. The main objective of tariff is to distribute equitably the cost of
- a. Installation & Fuel
  - b. Power transmission & distribution
  - c. Supplying energy among the various classification of users
  - d. Energy production among all its consumers
12. A transmission line of 210 km length has certain values of parameters A,B,C,D. If the length is made 100 km thus the parameter
- a. A increases, B decreases
  - b. A decreases, B also decreases
  - c. A and B both increase
  - d. A decreases, B increases
13. Maximum demand of a consumer is 2 kW and his daily energy consumption is 20 units. His load factor will be



- a. 10 %
  - b. 52 %
  - c. 41.6 %
  - d. None of the above
14. In order to have lower cost of electrical energy generation
- a. The load factor and diversity factor should be low
  - b. The load factor should be low but diversity factor should be high
  - c. The load factor should be high but diversity factor low
  - d. The load factor and diversity factor, both should be high
15. For the same power ratings, an alternator operating at lower voltage will be
- a. less noisy
  - b. costlier
  - c. larger in size
  - d. more efficient

***Tick whether the following statements is True or false.***

1. Nuclear power plants are used as Peak load plants. True / False
2. In MHD, seeding of the gas is done to increase conductivity. True / False
3. A power plant having maximum demand more than installed capacity will have utilization factor of less than unity. True / False
4. Slow neutrons are very efficient in causing fission of Uranium 235. True / False
5. In a transmission system, the size of the earth wire is determined by voltage of service wire. True / False