B.TECH/EE/7TH SEM/ELEC 4161 /2020

ADVANCED POWER SYSTEM
(ELEC 4161)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) What is the unit of incremental transmission loss?
(a) MW (b) $(MW)^{-1}$
(c) Unit less (d) $(MW)^2$.

(ii) What will be the penalty factor for a unit, if the incremental transmission loss is zero?
(a) 0 (b) 1
(c) -1 (d) ∞.

(iii) The phenomenon of rise in receiving-end voltage of the no load or lightly loaded long transmission line is called the
(a) proximity effect (b) skin effect
(c) Ferranti effect. (d) Seebeck effect.

(iv) What is the limit within which the consumer's end terminal voltage should be maintained?
(a) ± 6% (b) ± 10%
(c) ± 9% (d) ± 12%

(v) In HVDC system a converter acts as a rectifier when the firing angle α has a value
(a) $0^0 < \alpha < 120^0$ (b) $0^0 < \alpha < 90^0$
(c) $90^0 < \alpha < 180^0$ (d) $0^0 < \alpha < 180^0$.

(vi) In central AGC of a given control area, the change in frequency is
(a) area control error (b) volume control error
(c) nonlinear control error (d) optimal control error.

(vii) A cable has inductance of 0.22 mH per km and capacitance of 0.202 µF per km. The surge impedance of the cable is
(a) 28 Ω (b) 33 Ω (c) 40 Ω (d) 52 Ω .

(viii) Which of the following is non-linear diverter
(a) Rod gap type arrester (b) Valve type arrester
(c) Expulsion type arrester (d) Electrolytic type arrester.

(ix) In fly ball speed governor, the decrease in speed results
(a) when Fly ball moves outward (b) when Fly ball moves inward
(c) when Fly ball moves downward (d) when Fly ball moves upward.

(x) Kinetic Energy (K.E.) and frequency (f) of a synchronous machine are related as:
(a) K.E. $\propto 1/f$ (b) K.E. $\propto f$
(c) K.E. $\propto 1/f^2$ (d) K.E. $\propto f^2$.

Group – B

2. (a) Derive the condition for 'optimum generating scheduling' of thermal power plant including transmission losses. Hence define: (i) incremental transmission loss, (ii) penalty factor.

(b) In a two- plant system, the entire load is located at plant 2, which is connected to plant 1 by a transmission line. Plant 1 supplies 120 MW of power with a corresponding transmission loss of 6 MW. Calculate the penalty factors for the two plants.

(4 + 1 + 1) + 6 = 12

3. (a) Discuss different constraints of unit commitment problem.

(b) Two units have the following cost curves:

$$F_1 = 0.05\,P_{G1}^2 + 22\,P_{G1} + 120\ Rs/hr$$
$$F_2 = 0.06\,P_{G2}^2 + 16\,P_{G2} + 120\ Rs/hr$$

Where P_G is in MW. The limits of all the plants are as follows:

$$20\ MW \leq P \leq 100\ MW$$

How will a load of (a) 80 MW and (b) 200MW be shared?

6 + (3 + 3) = 12

Group – C

4. (a) Explain with necessary diagrams kinds of HVDC links used in HVDC systems.

(b) Write short notes on (i) Harmonic filters in HVDC System, (ii) Back to back HVDC station.

6 + (3 + 3) = 12

5. (a) Derive the expression of reflection and refraction co-efficient of voltage wave and current wave for resistive load.

(b) A voltage having crest value of 3000 kV is travelling on a 750 kV line. The protective level is 1800 kV and the surge impedance of the line is 300 Ω. Calculate (i) the current in the line before reaching the arrester, (ii) current through the arrester, (iii) the value of the arrester resistance for this condition and (iv) reflected voltage. Verify reflection & refraction coefficients.

6 + 6 = 12

Group – D

6. (a) Obtain the mathematical model and block diagram of generator model for steam power plant.

(b) Two generators rated 200 MW and 400 MW are operating in parallel. The droop characteristics of their governors are 4% and 5% respectively from no load to full load. Assuming that the generators are operating at 50 Hz at no-load, how would a load of 600 MW be shared between them? What would be the system frequency at this load? Assume free governor operation.

6 + 6 = 12

7. (a) Explain the combined operation of 'Load Frequency Control' and 'Excitation Voltage Control' with proper schematic diagram.

(b) "The operation of Excitation Voltage Control could not be affected by Load Frequency Control". Justify the statement.

(c) A 125 MVA turbo-alternator operates on full load at 50 Hz frequency. The load is suddenly reduced to 60 MW. The steam valves to the turbine commence to close after 0.5 seconds due to the time lag in the governor system. Assume the inertia constant, H= 5 kW-sec per kVA of generator capacity. Calculate the change in frequency that occurs in this time.

4 + 2 + 6 = 12

Group – E

8. (a) What do you mean by series compensation? Explain the advantages of series compensation. What are the problems associated with series compensation?

(b) A 400 V, 50 Hz, 3 phase system delivers 600kW at 0.75 power factor lag. Shunt capacitors are installed to raise the power factor to 0.9. Determine the kVAr rating per phase and the capacitance per phase needed if a delta connected capacitor bank is used.

(1 + 3 + 3) + 5 = 12

9. (a) What are FACTS? What are the basic types of FACTS controllers? What are the advantages of FACTS controllers?

(b) Describe the different SVS schemes commonly used in EHV/UHV transmission for voltage compensation.

(2 + 2 + 2) + 6 = 12

Department & Section	Submission Link
EE	https://classroom.google.com/c/MTIyOTkxODYwODkw/a/Mjc0MDMxNjU4MTgx/details