B.TECH/EE/7TH SEM/ELEC 4161/2018
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)　The characteristic impedance of a 250 km line is 400Ω. What will be the characteristic impedance of 200 km length of the same line?
(a) 320 Ω　　　(b) 400 Ω　　　(c) 500 Ω　　　(d) 125Ω.

(ii)　If the inertia constant H= 8 MJ/MVA for a 50 MVA generator, the stored energy is
(a) 50 MJ　　　(b) 8 MJ　　　(c) 400 MJ　　　(d) 6.25 MJ.

(iii)　How is the voltage and frequency controlled in automatic generation control?
(a) By controlling the excitation only
(b) By controlling the turbine action only
(c) Turbine speed control for voltage and excitation control for frequency
(d) Excitation control for voltage and turbine speed control for voltage.

(iv)　Which of the following is/are base load plants?
(a)diesel plants　　　　　　　　　　　(b) wind plants
(c)nuclear plants　　　　　　　　　　(d) all of the above.

(v)　Back to back HVDC is used to
(a) increase the transmission capability
(b) decrease the line losses
(c) provide the stable interconnection
(d) reduce voltage drop.

(vi)　If incremental transmission loss of a plant increases, the penalty factor of the plant
(a) increases　　　　　　　　　(b) decreases
(c) does not change　　　　　　(d) depends on incremental fuel cost.

(vii)　An overhead transmission line having surge impedance Z_1 is terminated to an underground cable of surge impedance Z_2. The reflection coefficient for the travelling wave at the junction of the line and cable is
(a) $(Z_1+ Z_2) / (Z_1- Z_2)$　　　　　(b) $Z_2 / (Z_1- Z_2)$
(c) $(Z_2- Z_1) / (Z_1+ Z_2)$　　　　　(d) $(Z_1- Z_2) / (Z_1+ Z_2)$.

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

(ix)　A synchronous condenser is a/an
(a) dc generator　　　　　　　　　　(b) induction motor
(c) overexcited synchronous motor　　(d) underexcited synchronous motor.

(x)　Ferranti effect in the transmission line occurs when the line is
(a) short and loaded　　　　　　(b) long and loaded
(c) long and unloaded　　　　　(d) short and unloaded

Group – B

2. (a)　Derive the condition for economic load scheduling of thermal power plants considering transmission losses. Hence define: (i) incremental transmission loss, (ii) penalty factor.

(b)　A system consists of two plants connected by a transmission line. The load is connected at plant 2. If a load of 125 MW is transmitted from plant 1 to the load, a loss of 12.5 MW will occur in the transmission line. Determine the generation schedule and the load demand if the cost of the received power is Rs 70/MWh. Assume that the incremental costs of the two plants are given by

$$\frac{dC_1}{dP_1} = 0.25P_1 + 40 \qquad Rs/MWh$$

$$\frac{dC_1}{dP_1} = 0.20P_2 + 40 \qquad Rs/MWh$$

(4 +1 + 1) + (4 + 2)=12

3.(a)　Write short notes on 'Hydro Thermal Scheduling'.

(b)　Derive the expression for the transmission loss in terms of loss coefficients.

5 + 7 = 12

Group – C

4. (a)　Why is the Surge Impedance in overhead lines more than in underground cables? Explain with proper derivation.

(b)　A 220 kV surge travels on a line of 500 Ω surge impedance and reaches a junction where two branch lines of surge impedances 350 Ω and 450 Ω, respectively are connected with the transmission line. Find the surge voltage and current transmitted into each branch line. Also find the reflected voltage and current.
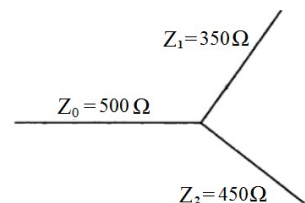

$Z_1 = 350Ω$
$Z_0 = 500 Ω$
$Z_2 = 450Ω$

Figure 1

4 +8 =12

5.(a) Explain different kinds of HVDC links used in HVDC system with necessary diagrams.

(b) An existing three-phase, double- circuit AC line is to be converted to three circuit DC line. Assuming the same insulation level and unity power factor in the ac systems, find (a) the ratio of power transmitted by DC to that by AC and (b) the ratio of percentage loss by DC to that by AC.

6 + (3 + 3)=12

Group – D

6. (a) What is AVR for a steam power plant ? Explain the Basic Working Principle of AVR.

(b) A 100 MVA synchronous generator operates on full load at a frequency of 60 Hz. The load is suddenly reduced to 60 MW. Due to time lag in governor system, the steam valve begins to close after 0.5 seconds. If inertia constant H= 5 kW/kVA, determine the change in frequency that occurs in this time.

6 + 6 =12

7.(a) Describe the construction and the basic working principle of Speed Governing System for a steam turbine.

(b) Two generators rated 200 MW and 400 MW are operating in parallel. The droop characteristics of their governors are 5% and 4% respectively from no load to full load. Assuming that the generators are operating at 60 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

Group – E

8. (a) Explain how series compensation leads to improvement in system stability. Compare the performances of series and shunt capacitors in a power system.

(b) Explain the working principle of STATCOM.

(3 + 4) + 5 =12

9. What are static var systems (SVS)? Describe the different SVS schemes commonly used in EHV/UHV transmission for voltage compensation. Write the advantages of SVS.

2+ 8 + 2 = 12