

**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 400 Ω. What will be the characteristic impedance of 200 km length of the same line?

(a) 320 Ω	(b) 400 Ω
(c) 500 Ω	(d) 125 Ω.
 - (ii) Which of the following decides the insulation level of 400 kV, EHV line?

(a) lightning voltage	(b) radio interference
(c) skin effect	(d) switching over voltage.
 - (iii) Under over excitation condition synchronous phase modifier works as

(a) shunt capacitor	(b) series capacitor
(c) shunt reactor	(d) series reactor.
 - (iv) Ferranti effect can be compensated by which of the following

(a) shunt capacitor	(b) shunt reactor
(c) series capacitor	(d) both (a) and (b).
 - (v) The protection against direct lightning strokes and high voltage steep waves is provided by

(a) earthing of neutral	(b) lightning arresters
(c) ground wires	(d) lightning arresters and ground wires.
 - (vi) What will be the penalty factor for a unit, if the generating station is located very close to load centre?

(a) Zero	(b) Almost equal to unity
(c) The penalty factor is negative	(d) The value is very high.

- (vii) Which of the following is/are base load plants?

(a) diesel plants	(b) wind plants
(c) nuclear plants	(d) all of the above.
- (viii) 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.
- (ix) In HVDC system

(a) both generation and distribution are dc	(b) generation is ac and distribution is dc
(c) generation is dc and distribution is ac	(d) both generation and distribution are ac.
- (x) The unit of speed regulation of governor is

(a) Hz	(b) Hz per MVA
(c) Hz per MW	(d) Hz per MVAR.

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) Two units have the following cost curves:

$$F_1 = 0.05P_{G1}^2 + 22P_{G1} + 120 \text{ Rs/hr}$$

$$F_2 = 0.06P_{G2}^2 + 16P_{G2} + 120 \text{ Rs/hr}$$
 Where P_G is in MW. The limits of all the plants are as follows:

$$20 \text{ MW} \leq P_G \leq 100 \text{ MW}$$
 How will a load of (i) 80 MW and (ii) 120 MW be shared?
 (6 + 1 + 1) + 4 = 12
3. (a) What do you understand by the long term hydro-thermal scheduling problem?

(b) Derive the "Transmission Loss Coefficients".
 4 + 8 = 12

Group – C

4. (a) Explain the advantages and limitations of HVDC transmission system.

(b) Write short notes on "MTDC systems".
 6 + 6 = 12

5. (a) Derive the expression of reflection and refraction co-efficient of voltage wave and current wave for a resistive load.
- (b) An overhead line with inductance and capacitance per kilometre length of 1.3 mH and 0.09 μ F respectively is connected in series with an underground cable (Figure-1) having inductance and capacitance 0.2 mH/km and 0.3 μ F/km respectively. If a surge having a maximum value of 100 kV travels along the line towards cable, determine the value of the reflected and transmitted wave of voltage and current at the junction. Also construct the Bewley's lattice diagram.

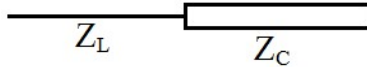


Figure-1

4 + 8 = 12

Group - D

6. (a) Explain the combined operation of 'Load Frequency Control' and 'Excitation Voltage Control' with proper schematic diagram.
- (b) "Excitation Voltage Control does not affect the operation of Load Frequency Control". Justify the statement.
- (c) A 100 MVA synchronous generator operates on full load at a frequency of 50 Hz. The load is suddenly reduced to 50 MW. Due to time lag in governor system, the steam valve begins to close after 0.4 seconds. If inertia constant $H = 5$ kW/s/kVA, determine the change in frequency that occurs in this time.
7. (a) Describe the construction and the basic working principle of Speed Governing System for a steam turbine.
- (b) Obtain the mathematical model and block diagram of the Speed Governing System for steam turbine.

5 + 2 + 5 = 12

6 + 6 = 12

Group - E

8. (a) What do you understand by transmission line compensation? What are active and passive compensators? Compare series and shunt compensation.
- (b) Write short notes on STATCOM.

(2 + 2 + 4) + 4 = 12

9. (a) 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