

SPECIAL SUPPLE 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) A cable has inductance of 0.22 mH per km and capacitance of 0.202 μ F per km. The surge impedance of the cable is
(a) 28 Ω (b) 33 Ω (c) 40 Ω (d) 52 Ω .
- (ii) What is the unit of transmission loss coefficient?
(a) MW (b) (MW)⁻¹ (c) Unit less (d) (MW)²
- (iii) 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.
- (iv) 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.
- (v) A synchronous condenser is a/an
(a) DC generator
(b) induction motor
(c) overexcited synchronous motor
(d) underexcited synchronous motor.
- (vi) 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 .

- (vii) In HVDC system
 (a) both generation and distribution are DC.
 (b) generation is ac and distribution are DC.
 (c) generation is dc and distribution is AC.
 (d) both generation and distribution are AC.
- (viii) The unit of speed regulation of governor is
 (a) Hz
 (b) Hz per MVA
 (c) Hz per MW
 (d) Hz per MVAR.
- (ix) Reactive power to HVDC system may be supplied from
 (a) AC filters
 (b) shunt capacitors
 (c) SVS
 (d) all of the above.
- (x) 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.

Group – B

2. (a) Discuss the following terms for thermal generating unit: (i) Incremental fuel cost, (ii) Incremental transmission loss, (iii) 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 100 MW of power with a corresponding transmission loss of 5 MW. Calculate the penalty factors for the two plants.

$$(2 + 2 + 2) + 6 = 12$$

3. (a) Derive the condition for ‘optimum generating scheduling’ of thermal power plant neglecting transmission losses.
- (b) The fuel costs of a two unit plant are given by:
 $C_1 = 100 + 2P_1 + 0.005 P_1^2$; $C_2 = 200 + 2P_2 + 0.01 P_2^2$
 Where P_1 and P_2 are in MW. The plant supplies a load of 450 MW. Find economic load scheduling of the two units and the incremental fuel cost. Neglect losses.

$$6 + (3 + 3) = 12$$

Group – C

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

- (b) Explain different kinds of HVDC links used in HVDC systems with necessary diagrams.

6 + 6 = 12

5. (a) Write short notes on Bewley's lattice diagram.

- (b) A surge of 100kV travelling in a line of natural impedance 600 ohms arrives at a junction of two lines of impedances 800 ohms and 200 ohms respectively. Find the surge voltages and currents transmitted into each of the branch lines.

6 + 3 + 3 = 12

Group - D

6. (a) 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 $H = 5$ kWs/kVA, determine the change in frequency that occurs in this time.

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

6 + (1 + 5) = 12

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

- (b) A Power system has a total load of 1250 MW at 50 Hz. The load varies 1.5% for every 1% change in frequency. Find the steady-state frequency deviation when a 60 MW load is suddenly tripped. The speed regulation parameter $R = 0.0025$ Hz per MW.

7 + 5 = 12

Group - E

8. (a) Show that the voltage control and reactive power control are interrelated.

- (b) Name the generators and consumers of reactive power in a power system.

- (c) What do you mean by transmission line compensation? What are active and passive compensators?

3 + 4 + (2 + 3) = 12

9. What do you mean by series compensation? Explain the advantages of series compensation. What are the problems associated with series compensation?

(2 + 5 + 5) = 12