

Indian Institute of Technology Patna  
Department of Electrical Engineering  
EE3101 - Power Systems-I  
Autumn - 2025  
Mid Semester Exam  
September 25, 2025

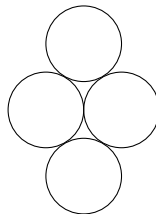
Total Marks : 25

Time: 2 Hours

**Section - A**

Each question carries two (2) marks.

1. Two loads connected in parallel are supplied from a three phase 400 V supply. The two loads draw a total real power of 400 kW at 0.8 power factor lagging. One of the load draws 120 kW at unity power factor. Find the real power in kW and the power factor of the second load.
2. The load factor of a consumer is 40 % and the monthly consumption is 500 kWh. If the tariff of electricity is Rs 50 per kW of maximum demand plus Rs 6 per kWh. Find the monthly bill,
3. A single phase load is supplied with a sinusoidal voltage  $v(t) = 200 \cos(377t)$  V. The resulting instantaneous power is  $p(t) = 800 + 1000 \cos(754t - 36.87^\circ)$  W. What are real power (P) and reactive power (Q)?
4. Determine the geometric mean radius (GMR) of the following configurations for inductance in terms of the radius  $r$  of the individual strand.



5. A three phase transmission line having 2 conductors per bundle is designed with equilateral spacing of  $D$  m. The spacing between the conductors of the bundle is  $d$  m. It is decided to build the line with horizontal spacing. The conductors are transposed. What should be the spacing between the adjacent conductors in order to obtain the same inductance as in the original design?

### Section - B

Each question carries five (5) marks.

1. A residential consumer has a connected load of 6 lamps each of 100 W and 4 fans of 60 W at his/her premises. His/her demand is as follows:

Time	Demand (W)
12 AM- 5 AM	120
5 AM - 6 PM	No Load
6 PM - 7 PM	380
7 PM - 9 PM	680
9 PM - 12 AM	420

- (a) Find the energy consumption during 24 hours.
- (b) Calculate the demand factor, average load, and load factor.
2. In a factory, there are following two loads :
- Lighting and heating load : 100 kW
- Induction motor load : 1000 HP at 0.7 lagging power factor and 85 % efficiency
- The overall load power factor of the factory has to be raised to 0.95 lagging. A 3-phase synchronous motor is installed for the above purpose. The synchronous motor is rated at 300 HP with 100 % efficiency. Find the power factor of the synchronous motor. Given 1 HP (horsepower) = 746 watts.
3. A 15 km long, 50 Hz, 3-phase overhead line delivers 5 MW at 11 kV at a power factor of 0.8 lagging. Line loss is 12 % of the power delivered. Line inductance is 1.1 mH per km per phase. Calculate:
- (a) Sending end voltage and voltage regulation.
- (b) Power factor of the load to make voltage regulation zero. (Hint: Use the phasor diagram with leading power factor.)