

KATHMANDU UNIVERSITY
End Semester Examination [C]
May/June, 2019

Marks scored:

Level : B.E.

Year : III

Exam Roll No.:

Time : 30 mins.

Course : EPEG 302

Semester: I

F.M. : 10

Registration No.:

Date 30 MAY 2019

SECTION "A"
[20Q. × 0.5=10 marks]

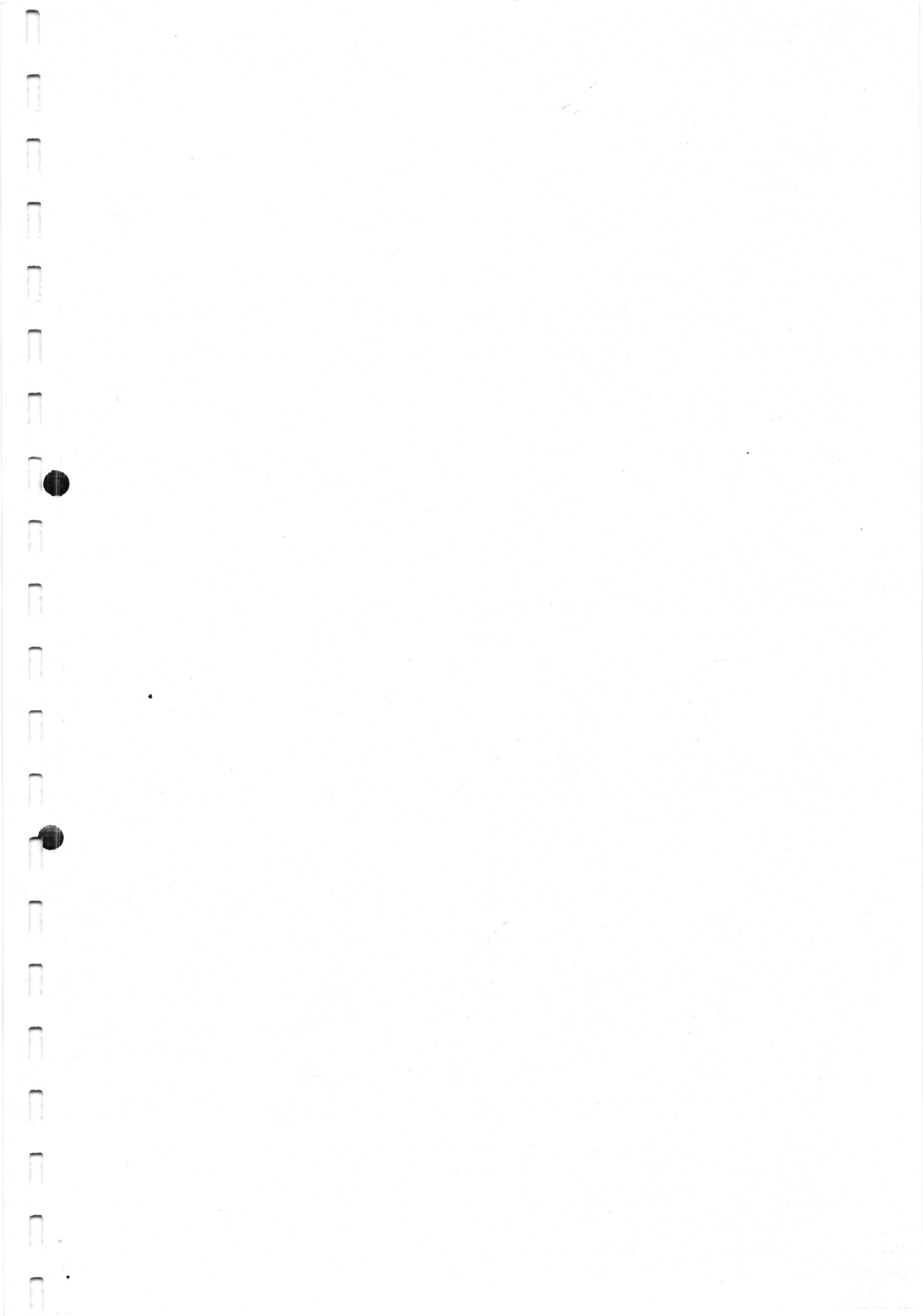
Choose the most appropriate answer among the given options and encircle the letter of your choice.

1. A three phase transformer has its primary connected in delta and secondary connected in star. Secondary to primary turns ratio per phase is 5. For a primary voltage of 400 V, the secondary voltage would be
a. 2000 V. b. 80 V. c. 3464 V. d. $80\sqrt{3}$ V.
2. For a core type power transformer, both primary and secondary windings have circular cross sections, because the cross section
a. is easier to wind.
b. requires minimum copper and, therefore, less I^2R loss.
c. has the strongest mechanical shape.
d. results in less core material and, therefore, less core loss.
3. Two transformers are connected in parallel. These transformers do not have equal percentage impedance. This will likely result in
a. short circuiting of the secondaries.
b. power factor of one of transformer is leading while that of other is lagging.
c. transformer with higher copper losses will have negligible core losses.
d. loading of the transformer not in proportion to their kva ratings.
4. The changes in volume of transformer cooling oil due to variation of atmospheric temperature during day and night is controlled by
a. conservator. c. bushings.
b. breather. d. buchholz relay.
5. Regulation of a transformer becomes closer to zero on
a. full load. c. leading power factor.
b. overload. d. zero power factor.
6. Rotor slots of squirrel cage induction motor are skewed slightly, so as to
a. increase the mechanical strength of the rotor.
b. make the rotor construction simple.
c. save the amount of copper required.
d. eliminate locking tendency of rotor and to reduce the noise.
7. A three phase slip ring induction motor has 4 pole stator and 2 pole rotor. If the stator is energized from 50 Hz source, the rotor would run at a speed
a. slightly less than 1500 r.p.m. c. slightly less than 1200 r.p.m.
b. slightly less than 3000 r.p.m. d. of zero r.p.m.

8. A three phase, 50 Hz, 4 pole squirrel cage induction motor has its stator rewound for 6 poles without any alterations in its rotor. The motor would now run at a speed
- less than 1000 r.p.m.
 - less than 1500 r.p.m.
 - less than 3000 r.p.m.
 - zero r.p.m.
9. In a 3 phase induction motor, for slip s , the mechanical power, P_m developed in terms of air gap power, P_g is
- $(s-1) P_g$.
 - $P_g / (1-s)$.
 - P_g/s .
 - $(1-s) P_g$.
10. In a 3 phase induction motor, the electrical representation of the variable mechanical load is the resistance, for slip s , is equal to
- $r_2 (s-1)$.
 - $r_2 (1-s)$.
 - $r_2 (1/s-1)$.
 - $r_2 (1-1/s)$.
11. A 3 phase, 50 Hz induction motor takes a power input of 30 kW at its full load speed of 1440 r.p.m. The stator losses are 1kW. The slip and rotor ohmic losses at full load are
- 0.02, 600 W.
 - 0.04, 580 W.
 - 0.04, 1160 W.
 - 0.04, 1200 W.
12. For a 3 phase, 50 Hz, squirrel cage induction motor, rotor leakage reactance at standstill is twice of its resistance. The frequency of the supply at which maximum torque is obtained at starting torque is
- 50 Hz.
 - 25 Hz.
 - 100 Hz.
 - 75 Hz.
13. The power factor of a delta connected 3 phase, 50 kW induction motor is 0.4, when delivering 35% of its rated load. If its stator is reconnected in star, then its
- p.f is improved, stator current decreases.
 - p.f is improved, stator current increases.
 - p.f is worsened, stator current increases.
 - p.f remains unchanged, stator current decreases.
14. In a 3 phase induction motor, the relation between electrical torque, T_e at any slip, s and the slip s at maximum torque T_{em} occurs is given by
- $T_e/T_{em} = 2s \cdot s_m T / (s^2 + s_m T^2)$.
 - $T_e/T_{em} = 2s_m T / (s^2 + s_m T^2)$.
 - $T_e/T_{em} = 2s / (s^2 + s_m T^2)$.
 - $T_e/T_{em} = s / (s^2 + s_m T^2)$.
15. An alternator and a synchronous motor are connected to an infinite bus. Both are working at unity p.f. For reactive power requirements
- both deliver it to the bus.
 - both absorb it from the bus.
 - alternator is delivering it and motor is absorbing it.
 - neither of these machines is delivering nor absorbing it.
16. A synchronous machine has its field winding on the rotor and armature winding on the stator. When running at steady conditions, its air gap field is
- stationary with respect to stator.
 - rotating at synchronous speed with respect to rotor.
 - rotating at synchronous speed against the direction of rotor rotation.
 - rotating at synchronous speed in the direction of rotor rotation.

30 MAY 2015

17. A 3 phase synchronous generator is operating at zero p.f lagging with respect to the excitation voltage. The armature reaction m.m.f produced by the armature currents is
- magnetizing in nature.
 - demagnetizing in nature.
 - cross magnetizing in nature.
 - both demagnetizing and cross magnetizing in nature.
18. A synchronous machine is called doubly excited machine because
- it can be overexcited.
 - it has two set of rotor poles.
 - both its stator and rotor are excited.
 - it needs twice the normal exciting current.
19. Synchronous capacitor is
- an ordinary static capacitor bank.
 - an over excited synchronous motor driving mechanical load.
 - an under excited synchronous motor running without mechanical load.
 - an over excited synchronous motor running without mechanical load.
20. Three water turbine driven identical alternators are running in proper synchronism and carry equal loads. If excitation of one alternator is increased without changing its input water turbine supply
- | | |
|---------------------------------------|--|
| a. kVA supplied by it would decrease. | c. kVAR supplied by it would decrease. |
| b. it will keep supplying same load. | d. its power factor will increase. |



KATHMANDU UNIVERSITY
End Semester Examination [C]
May/June, 2019

30 MAY 2019

30 MAY 2019

Level : B.E.
Year : III
Time : 2hrs. 30 mins.

Course : EPEG 302
Semester : I
F.M. : 40

SECTION "B"
[5Q. × 8 = 40 marks]

Attempt ANY FIVE questions. Assume any suitable data if required.

1.

- a. A 3 phase 1000 kVA, 6600/1100V transformer is delta connected on the primary and star connected on the secondary. The primary resistance per phase is 1.8Ω and secondary resistance per phase is 0.025Ω . Determine the efficiency on full load at 0.8 p.f lagging if the iron loss is 15 kW. [1+1=2]

- b. Two transformers are connected in parallel to a load of $(2+j1.5) \Omega$. Find the
i. power output and,
ii. power factor of each transformer, if following data pertain to two transformers

Transformer A	Transformer B
Impedance in secondary, $Z_A = (0.15+j0.5)\Omega$	Impedance in secondary, $Z_B = (0.1+j0.6)\Omega$
Induced e.m.f, $E_A = 207 \angle 0^\circ$ volts	Induced e.m.f, $E_B = 205 \angle 0^\circ$ volts

- c. Describe the shell and core type construction of a 3 phase transformer. [2+2=4] [2]

2.

- a. Explain the operating principle of a 3 phase induction motor. Describe the torque slip and torque speed characteristics of a 3 phase induction motor. [2+2=4]
- b. Explain the effect of change in supply voltage on starting torque, running torque and slip for a 3 phase induction motor. [2]
- c. A 3 phase slip ring induction motor gives a reading of 60 V across slip rings on open circuit when at rest with normal stator voltage applied. The motor is star connected and has an impedance of $(0.6+j6) \Omega$ per phase. Find the rotor current and power factor when the machine is
i. At standstill with slip rings joined to a star connected starter with a phase impedance of $(5+j4) \Omega$ and,
ii. Running normally with a 4 percent slip. [1+1=2]

3.

- a. A 12 pole, 3 phase slip ring induction motor takes 270 kW from a 50 Hz supply and runs at 485 r.p.m. The total stator loss is 10 kW and efficiency is 93%.
i. Determine the mechanical losses.
ii. If speed for same input is reduced by 400 r.p.m by adding resistance in the rotor circuit, find the output power and overall efficiency. [1+1=2]

b. The following data refer to a 10 pole, 400V, 50 Hz, 3 phase induction motor:

$$R_1 = 1.75 \Omega,$$

$$X_1 = 5.5 \Omega,$$

$$R_1' \text{ (rotor resistance referred to stator)} = 2.25 \Omega,$$

$$X_2' \text{ (rotor standstill reactance referred to stator)} = 6.6 \Omega$$

When the motor is tested on no load, it is observed that it takes 3.8 A (line current) and the total core loss is 310 W. By using an approximate equivalent circuit similar to that of a transformer at 4% slip, calculate

- i. The rotor current.
- ii. Supply current and power factor.
- iii. Mechanical power developed
- iv. Gross load torque and

[1+1+1+1=4]

c. Derive the induction motor induced torque equation using Thevenin's Theorem to the per phase equivalent circuit of the induction motor. [2]

4.

a. Explain the split phase capacitor start single phase induction motor showing circuit diagram, vector diagram and torque speed characteristics. [3]

b. Explain the V-curve characteristic of a synchronous motor showing the relationship between armature current and field current for various loads. [3]

c. A 400 V, single phase synchronous motor gives a net output mechanical power of 7.35 kW and operates at 0.92 p.f lagging. Its effective resistance is 0.7 Ω . If the iron and mechanical losses are 550 W and excitation losses are 750 W, calculate the armature current. [2]

5.

a. A single phase 600 V, 60 kVA alternator has an effective resistance of 0.2 Ω . A field current of 10 A produces an armature current of 210 A on short circuit and an e.m.f of 480 V on open circuit. Calculate,

- i. Synchronous impedance and reactance.
- ii. Full load regulation with 0.8 p.f lagging.

[1.5+1.5=3]

b. A 3 phase star connected alternator is delivering 20 MW and 8 MVA to an infinite bus at 11 kV. The alternator has an synchronous impedance of $(0+j3) \Omega$. Determine,

- i. Load angle and,
- ii. Excitation emf of the alternator.

[2]

c. Derive the expression for power developed by a salient pole 3 phase synchronous generator. [3]

30 MAY 2019

- 6.
- a. Two alternators working in parallel supply light load of 3000 kW at unity p.f. and a motor load of 5000 kW at a p.f. of 0.72. One alternator is loaded up to 5000kW at 0.8 p.f. lagging. What is the load and power factor of the other alternator? [2]
 - b. The Power Lab at Department of Electrical and Electronics Engineering in Kathmandu University is supplied by an external 380 V three-phase power supply. The lab includes four three phase supply loads.
 - Load *A* is 75 kVA induction motor running a 0.85 p.f. lagging.
 - Load *B* is 80 kVA synchronous generator running at 0.9 p.f. lagging.
 - Load *C* is an induction motor located at Turbine Testing Lab and is supplied from power lab. The rating of load *C* is 200 kVA running at 0.8 p.f lagging,
 - Load *D* is a synchronous motor and is rated at 150 hp, 400 V, and 0.8 p.f. leading.

The synchronous reactance is 1 per unit and armature resistance is 0.05 per unit.

- i. Find the current flowing in the distribution line before and after addition of the synchronous condenser.
 - ii. Calculate the cost of energy before and after addition of the synchronous motor to the system, if the plants are operated for 3 hours in any particular day. Assume, energy tariff of NRs. 10 unit.
- [2+2=4]
- c. Explain the effect of armature reaction on a synchronous generator for leading power factor loads, lagging power factor loads and unity power factor loads. [2]

