

KATHMANDU UNIVERSITY
End-Semester Examination
February/March, 2018

Marks Scored:

Level : B.E.
Year : III

Course : EPEG 302
Semester: I

Exam Roll No.:

Time : 30 mins.

F.M. : 10

Registration No.:

Date MAR 05, 2018

SECTION "A"

[20 Q x 0.5=10 marks]

Choose the most appropriate answer.

1. The chemical used in breather of transformer should have the property of
 - a. Ionizing air.
 - b. Cleansing the transformer oil.
 - c. Absorbing moisture.
 - d. Cooling the transformer oil.
2. The material used for construction of transformer core is usually
 - a. Iron.
 - b. Copper.
 - c. Aluminium.
 - d. Silicon steel.
3. The function of a conservator in transformer is
 - a. To protect against internal fault.
 - b. To reduce copper as well as core losses.
 - c. To cool the transformer oil.
 - d. To provide space for expansion and contraction of transformer oil.
4. The type of winding used in shell type transformer is
 - a. Circular type.
 - b. Sandwich type.
 - c. Cylindrical type.
 - d. Rectangular type.
5. Power transformers are generally designed to have maximum efficiency around
 - a. No load.
 - b. Half load.
 - c. full load.
 - d. 10% over load.
6. The starting torque of a squirrel cage induction motor is
 - a. Low.
 - b. Same as full load torque.
 - c. Slightly more than full load torque.
 - d. Equal to the pull out torque.
7. A double squirrel cage induction motor is one in which there are
 - a. Two rotors moving in opposite direction.
 - b. Two parallel windings in rotor.
 - c. Two parallel windings in stator.
 - d. Two series winding in rotor.
8. The crawling of an induction motor is caused by
 - a. High loads.
 - b. Low voltage supply.
 - c. Improper design of machine.
 - d. Harmonics developed in motor.

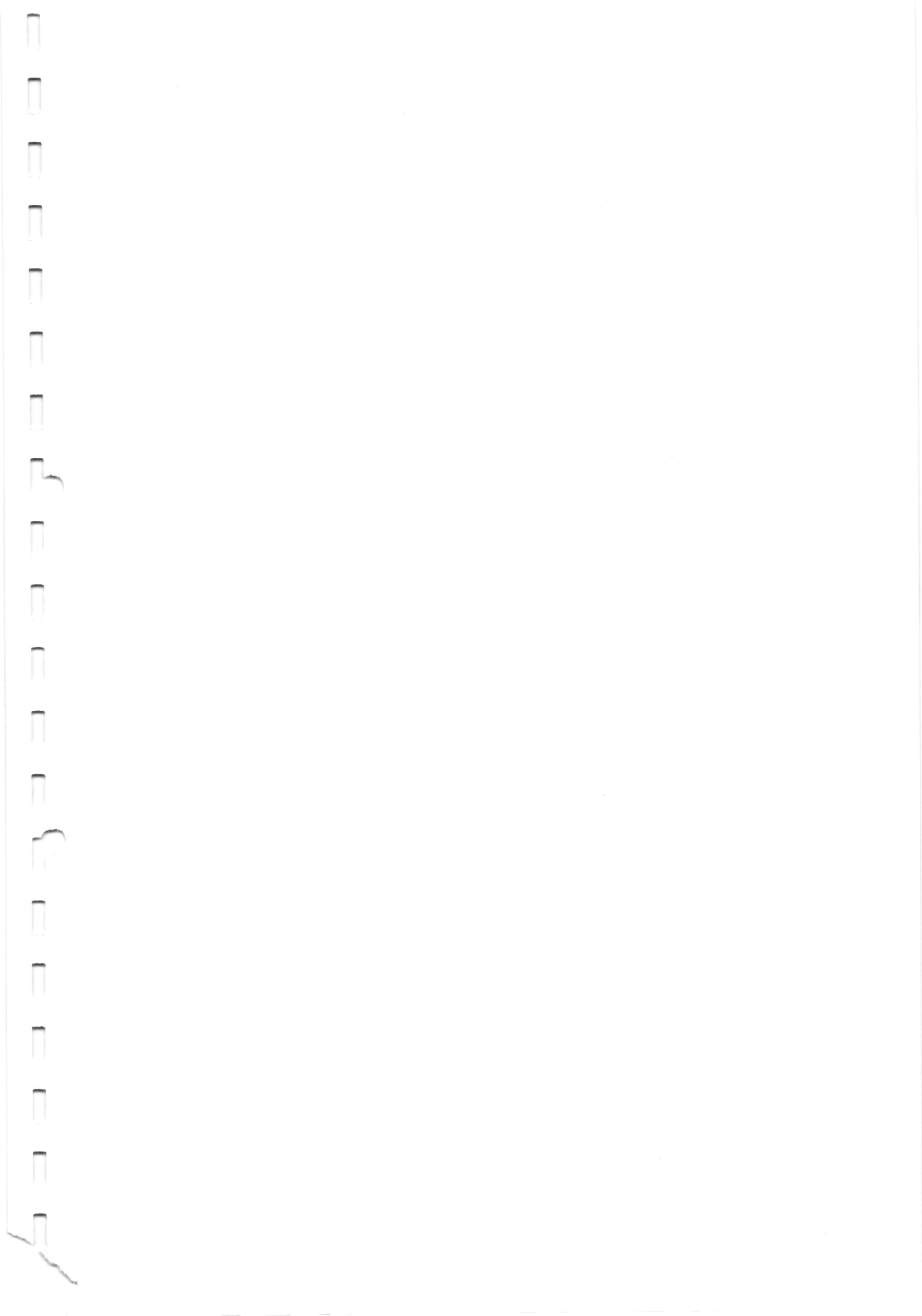
9. In an induction motor slip, s equals
 a. $\frac{Ns-N}{Ns}$. b. $\frac{Ns-N}{N}$. c. $\frac{N-Ns}{Ns}$. d. $\frac{N-Ns}{N}$.
 where, N_s = synchronous speed and N = rotor speed.
10. The condition for maximum torque under running condition at supply frequency, if R_2 = rotor resistance, X_2 = rotor reactance and s = slip will be when
 a. $R_2 * X_2 = 1$. b. $s * R_2 = X_2$. c. $R_2 = s * X_2$. d. $R_2 = s^2 * X_2$.
11. The principle of operation of a three phase induction motor closely resembles to that of
 a. Synchronous motor.
 b. D.C series motor.
 c. Transformer with short circuited secondary.
 d. Transformer with open circuited secondary.
12. In a capacitor start and run induction motors the function of the running capacitor in series with auxiliary winding is to
 a. Improve power factor. b. Increase overload capacity.
 c. Reduce fluctuation in torque. d. Improve torque.
13. The centrifugal switch is used to disconnect the starting winding when the induction motor has
 a. Run for about 1 minute.
 b. Run for about 5 minutes.
 c. Picked up about 75% of rated speed.
 d. Picked up about 10 to 25% of rated speed.
14. The synchronous motors are not self-starting because
 a. Direction of rotation is not fixed.
 b. The direction of instantaneous torque reverses after half cycle.
 c. Starters cannot be used in these machines.
 d. Starting winding is not provided in these machines.
15. A synchronous motor can be used as a synchronous condenser when it is
 a. Under loaded. b. Over loaded.
 c. Under excited. d. Overexcited.
16. The oscillation in a synchronous motor can be damped out by
 a. Maintaining constant excitation.
 b. Running the motor on leading power factors.
 c. Providing damper bars in the rotor pole faces.
 d. Oscillation cannot be damped out.
17. An alternator is connected to an infinite busbars. Its excitation is increased while its driving power remains constant. This will result in
 a. Less lagging power factor.
 b. More lagging power factor.
 c. Terminal voltage drop.
 d. Terminal voltage increase.

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18. The armature reaction of an alternator influences
 - a. Operating speed.
 - b. Waveform.
 - c. Windage loss.
 - d. E.m.f per phase.

19. A negative regulation can be expected in case of
 - a. Lagging power factor load.
 - b. Leading power factor load.
 - c. Unity power factor load.
 - d. High speed alternators.

20. If two alternators are running in proper synchronism and the voltage of machine is suddenly increased
 - a. The machines will stop.
 - b. The machines will burn out.
 - c. Synchronizing torque will be produced to restore further synchronism.
 - d. There is no change in the system performance.



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Time : 2hrs. 30 mins.

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Semester : I
F.M. : 40

SECTION "B"

[5 Q.×8=40 marks]

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

1.
 - a. The exciting current of a 1-phase, 10 kVA, 2200/220 V, 60 Hz transformer is 0.25 A when measured on the high-voltage side. Its equivalent impedance is $10.4 + j31.3 \Omega$ when referred to the HV side. Taking the transformer rating as base,
 - i. Determine the base values of voltages, currents, and impedances for both high-voltage and low-voltage sides.
 - ii. Express the exciting current and impedance in per-unit form for both high voltage and low voltage sides.
 - iii. Determine the per-unit voltage regulation (using the per-unit equivalent circuit from part (iii)) when the transformer delivers 75% full load at 0.6 lagging power factor. [1+1+1=3]
 - b. Explain Scott connection method of converting three phase supply into two phase supply using single phase transformers. [5]
2.
 - a. Describe the double field revolving theory of a single phase induction motor. [4]
 - b. A double cage induction motor has the following equivalent circuit parameters, all of which are phase values referred to the primary

Stator	$R_1 = 1.0\Omega$	$X_1 = 2.8\Omega$
Outer cage	$R_{2o}' = 3.0\Omega$	$X_{2o}' = 1.0\Omega$
Inner cage	$R_{2i}' = 0.5\Omega$	$X_{2i}' = 5.0\Omega$

The primary is delta connected and supplied from 440V. Calculate the starting torque when running at slip of 4%. The magnetizing branch is assumed to be negligible. [4]
3.
 - a. A 3 MVA, 6 pole alternator runs at 1000 r.p.m in parallel with other machines on 3.3 kV busbars. The synchronous reactance is 25 percent. Calculate, synchronizing power per mechanical degree of rotor displacement at no load and corresponding synchronizing torque. [2]

- b. Explain hunting of a synchronous generator. [3]
c. Consider, alternator A is synchronized with alternator B. Explain the effect of speed change in synchronization action if speed of alternator B falls. [3]

4.

- a. A 208 V, 45-kVA, 0.8 power factor-leading, Δ connected, 60 Hz synchronous machine has a synchronous reactance of 2.5Ω and a negligible armature resistance. Its friction and windage losses are 1.5 kW, and its core losses are 1.0 kW. Initially, the shaft is supplying a 15 hp load, and the motor's power factor is 0.80 leading.
- Sketch the phasor diagram of this motor, and find the values of armature current, I_A , load current, I_L and back e.m.f, E_b .
 - Assume that the shaft load is now increased to 30 hp. Sketch the behavior of the phasor diagram in response to this change.
 - Find I_A , I_L , and E_b after the load change. What is the new motor power factor? [1+2+1=4]

- b. Explain the V-curve characteristic of a synchronous motor showing the effect of change in field current and load on the motor with the aid of a phasor diagram indicating load angle, δ , power factor angle, ϕ , armature current, I_a , e.m.f, E_A and synchronous reactance, X_s . [4]

5.

- a. Consider an isolated micro hydropower plant where 3-phase induction motor driven by a hydro turbine is implemented as an induction generator using capacitor of proper size to electrify a remote village where grid supply has not reached. Explain the working principle of operating induction motor as a generator without an external supply system showing the torque speed characteristic of an induction machine. [3]
- b. An industrial plant is connected to an infinite bus operating at 480 V through 11 kV transmission line. The major loads are classified as:
- Load 1 is an elevator operated by a 3 phase induction motor consuming 100 kW at 0.78 pf lagging.
 - Load 2 is a conveyer belt operated by an induction motor consuming 200 kW at 0.8 pf lagging.
 - Load 3 is a synchronous motor whose real power consumption is 150 kW.
 - If the synchronous motor is adjusted to operate at 0.85 lagging, what is the transmission line current?
 - If the synchronous motor is adjusted to operate at 0.85 leading, what is the transmission line current?
 - Discuss what you obtained with variation in power factor of the synchronous motor in terms of transmission losses. [2+2+1=5]

- 6.
- a. Obtain the expression for power developed by a salient pole synchronous machine.
A 10 kVA, 380 V, 50 Hz, 3 phase, star connected salient pole alternator has direct and quadrature axis reactance of 12Ω and 8Ω respectively. The armature has a resistance of 1Ω per phase. The generator delivers rated load at 0.8 power factor lagging with the terminal voltage being maintained at rated value. If the load angle is 16.15° , determine excitation voltage of generator. [3+2=5]
- b. A three phase step down transformer takes 15A when connected to 4400V mains. The turn ratio per phase is 10. Neglecting losses, find the secondary line voltage, line current and output if the transformer windings are connected
- Star/delta connected.
 - Delta/star connected. [1.5+1.5=3]

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