BM-(O)EE-II/17

2017

ELECTRICAL ENGINEERING - PAPER-II

Time Allowed : 3 Hours

Full Marks : 200

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in English or in Bengali but all answers must be in one and the same language.

Answer any 5 questions.

All symbols have their usual significance

1. a) Explain how the primary current increase as the current on the secondary side of the single-phase transformer is increased.

b) A 20kVA, 8000/480V,50Hz, single-phase transformer has the following equivalent circuit shown in fig.1 referred to the high-voltage side, calculate
(i) the per-unit equivalent circuit of this transformer and
(ii) If the transformer is supplying rated load at 480 V and 0.8 PF lagging, what is its voltage regulation as well as efficiency?

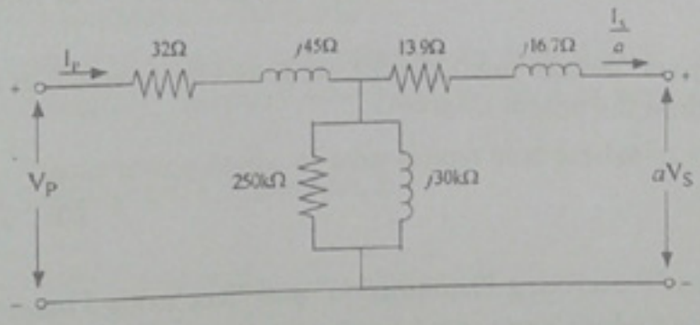

Fig. 1

c) Show how three-phase transformers **Dy11** and **Yd1** can be connected in parallel successfully.

10+20+10=40

2. a) A 6 pole DC machine has 300 armature conductors where each conductor carrying 80 A. The magnetic flux per pole is 0.015 Wb and machine is driven at 1800 r.p.m. Compute average e.m.f generated, power developed and electromagnetic torque if the armature conductor are: (i) WAVE connected & (ii) LAP connected.

b) Why a starter is required in dc motor? Also describe a starter.

c) A 15-hp 230-V 1800 r/min shunt dc motor has a full-load armature current of 60 A when operating at rated conditions. The armature resistance of the motor is R_A = 0.15 Ω, and the field resistance R_F is 80 Ω. The adjustable resistance in the field circuit R_{adj} may be varied over the range from 0 to 200 Ω and is currently set to 90 Ω. Armature reaction may be ignored in this machine. The magnetization field current of 1.35A would produce an armature emf E_{A0} of 221 V at no load, at a speed of n_o = 1800 r/min. for this motor:

(i) What is the speed of this motor when it is running at the rated conditions specified above?

(ii) What are the copper losses and rotational losses in the motor at full load (ignore stray losses)? and

(iii) What is the efficiency of the motor at full load?

10+10+20=40

3. a) Showing a suitable 3-phase conductors arrangement diagram in a cross section of a stator of a three-phase induction machine ,describe how two poles rotating magnetic fields is produced in the machine by 3-phase ,50Hz armature currents and show at least two positions of poles-rotating with corresponding currents in stator conduc

b) A 3-phase, 4-pole, 50 hp, 440 V, 50Hz, Y-connected induction motor has the following circuit parameters per phase :stator resistance,R_1=0.10Ω,stator leakage reactance X_1=0.35Ω, rotor resistance referred to stator R'_2=0.12Ω and rotor leakage reactance referred to stator X'_2=0.40Ω. It is known that the stator core loss amounts to 1200 W and the rotational losses equal 950 W. Moreover, at no-load the motor draws a line current of 18 A at a power factor of 0·089 lagging. When the motor operates at a slip of 2·5% at load, find the input line current, power factor and efficiency and also find maximum torque and the slip at which it will occur. 15+25=40

4. a) Explain briefly, a Synchronous Condenser of a power system that can generate or absorb reactive power.

b) With the help of schematic diagram ,explain how a zero power factor lagging armature current has the effect of strengthening the main field by the armature reaction in a 3-phase Synchronous Motor and also show that electromagnetic force/torque is produced in rotor is zero then.

c) A 2300-V , 1000-kVA, 0.8-PF-lagging, 50-Hz ,two-pole ,Y-connected Synchronous Generator in power plant has a per phase synchronous reactance of 1.1 Ω and an armature resistance of 0.15 Ω. At 50 Hz, its friction and windage losses are 24 kW, and its core losses are 18 kW. Assume that the field current of the generator is adjusted to achieve rated voltage (2300 V) at full load conditions in each of the questions below.

What are the efficiency and voltage regulation of the generator operated at rated kilo-voltamperes at 0.8-PF-lagging? Also draw the phasor diagram .

d) Synchronous Generator of salient pole type is used in which power plant?

10+10+15+5=40

5. a) Differentiate between "Re-striking Phenomenon" and "Reclosing Phenomenon" in a circuit breaker. Which one is harmful and which one is useful and why?

b) A 2-wire DC ring distributor is 300 m long and is fed at 240 V at point A. At point B, 150 m from point A, a load of 120 amps is taken and at point C, 100 m in the opposite direction, a load of 80 amps is taken. If the resistance per 100 m of single conductor is 0.03 Ω, find :

(i) Current in each section of distributor.

(ii) Voltage at points B and C.

c) An insulator string consists of three units, each having a safe working voltage of 15 kV. The ratio of self- capacitance to shunt capacitance of each unit is 8:1. Find the maximum safe working voltage of the string. Also find the string efficiency. 10+10+10+10=40

d) With a neat sketch, explain the Buchholz relay.

6. a) Draw the circuit diagram and explain working of a fluorescent lamp explaining the task of choke and starter. Why sodium vapour light is used?

b) Discuss about why dc series motor is used in traction?

c) Explain plugging and regenerative braking as applied to traction motors.

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d) Explain the theory of v/f control in detail.

10+10+10+10=40

7. a) Explain the operation of a chopper control of a separately excited DC motor.
b) Explain the operation of VSI (voltage source inverter) fed 3-phase induction motor drives.

c) Describe turning on an SCR using two-transistor analogy.

d) Explain the operation turning on and off in the view of equivalent circuit of the MOSFET with the help of neat structural diagram and suitable wave forms. What is Miller capacitance?

10+10+10+10=40

8. a) Explain the modulation techniques: AM & FM.
b) Discuss about performance of communication system by optical fibre.
c) What is Induction Generator? Describe how it can be used to have electrical power from a wind energy system.
d) Describe electric arc welding and a scheme for it.

10+10+10+10=40