

---

**BITS, PILANI – DUBAI CAMPUS**  
**FIRST SEMESTER 2012 – 2013**  
**EEE/INSTR/ ECE F211 ELECTRICAL MACHINES**  
**COMPREHENSIVE EXAMINATION (CLOSED BOOK)**

**MAXIMUM MARKS: 60**  
**DATE: 06.01.13**

**WEIGHTAGE: 30 %**  
**DURATION: 3 hours**

---

**NOTE:** 1) Attempt PART A and PART B in separate booklets.  
2) Attempt all parts of a question sequentially.  
3) If a question is answered twice and not cancelled, only the first attempt will be evaluated.  
4) Show calculations stepwise.  
5) Sketches/ diagrams/ graphs are to be complete.

**PART A**

- 1) Obtain the equivalent circuit of a 200 / 400 V, 50 Hz single phase transformer from the following test data: **[8M]**

OC test (LV side): 200 V, 0.7 A, 70 W  
SC test (HV side): 15 V, 10 A, 85 W

Calculate the secondary voltage when delivering 5 kW at 0.8 pf lagging, the primary voltage being 200 V.

- 2) A three-phase bank of 3 single-phase transformer are fed from three-phase 66 kV (line-to-line). It supplies a load of 6000 kVA at 33 kV (line-to-line). Both supply and load are 3-wire. Calculate the voltage rating (primary side to secondary side ratio) of the single phase transformer for the following 3-phase transformer connections: **[8M]**

- 2A) Star-Star  
2A) Star-Delta  
2B) Delta-Star  
2C) Delta-Delta

- 3) A 200 V dc shunt motor takes 4A at no-load when running at 700 rpm. The field resistance is 100  $\Omega$ . The resistance of armature at standstill gives a drop of 6V across armature terminals when 10 A were passed through it. The full- load input to the motor is 8 kW. Calculate the following, at full-load: **[8M]**

- 3A) Speed  
3B) Torque in N-m  
3C) Efficiency

- 4) Draw a neat diagram to conduct the Hopkinson's test on dc machines. Also list three advantages and disadvantages of the test. **[6M]**

[Please turn over]

## PART B

- 5) The Hopkinson's test on two dc machines gave the following results for full load:  
Line voltage 250 V; Line current, excluding field current, 50 A; Motor armature current 380 A;  
field currents 5 A and 4.2 A for generator and motor respectively. Armature resistance of each  
machine = 0.02  $\Omega$ . Calculate the efficiency of each machine. State the assumptions made. [10 M]
- 6) A 18.65 kW, 4 pole, 50 Hz, three phase induction motor has friction and windage losses of 2.5%  
of the output. The full load slip is 4%. Compute for full load: [10 M]
- 6A) Rotor copper loss  
6B) Power across airgap  
6C) Gross torque (or electromagnetic torque)  
6D) Torque in synchronous watts
- 7) A three phase, 1500 kVA, 50 Hz, 2300 V, star-connected synchronous generator has the  
following data: A field current of 70 A produces a short circuit current equal to full-load current of  
376 A in each line. The same field current produces an emf of 700 V on open circuit.  $R_a$  of the  
machine can be neglected. Determine the following: [7 M]
- 7A) Synchronous reactance of the machine  
7B) Percentage regulation at full-load, 0.8 pf lagging
- 8) Draw a connection diagram for connecting the synchronous machine to infinite bus bars. [3 M]
-

---

**BITS, PILANI – DUBAI CAMPUS**  
**FIRST SEMESTER 2012 – 2013**  
**EEE/INSTR/ ECE F211 ELECTRICAL MACHINES**  
**TEST 2 (OPEN BOOK)**

**MAXIMUM MARKS: 20**  
**DATE: 09.12.12**

**WEIGHTAGE: 10 %**  
**DURATION: 50 MINUTES**

---

**NOTE:** 1) Attempt all parts of a question sequentially. 2) If a question is answered twice and not cancelled, only the first attempt will be evaluated. 3) Show calculations stepwise. 4) Sketches/ diagrams are to be complete.

1. A separately excited DC motor is operating at an armature voltage of 300 V. Its no-load speed is 1200 rpm. When fully loaded, it delivers a motor torque of 350 Nm and its speed drops to 1100 rpm. Find the

1A) Full load current and power.

1B) Armature resistance of the motor

**[6 Marks]**

If the above motor is fully loaded and fed with an armature voltage of 600 V (while its excitation is held same as before), Calculate the Motor torque, Power and Speed.

**[6 Marks]**

2. A 4 pole, 50 Hz three phase induction motor has, at rated voltage and frequency, a starting torque of 160 percent of full-load torque and a maximum torque of 200 percent of full-load torque. Determine

2A) full load speed

2B) speed at maximum torque

2C) Frequency of rotor emf corresponding to maximum torque

**[5+2+1 Marks]**

---

---

**BITS, PILANI – DUBAI CAMPUS**  
**FIRST SEMESTER 2012 – 2013**  
**EEE/INSTR/ ECE F211 ELECTRICAL MACHINES**  
**TEST 1 (CLOSED BOOK)**

**MAXIMUM MARKS: 30**  
**DATE: 15.10.12**

**WEIGHTAGE: 15 %**  
**DURATION: 50 MINUTES**

---

**NOTE:** 1) Attempt all parts of a question sequentially. 2) If a question is answered twice and not cancelled, only the first attempt will be evaluated. 3) Show calculations stepwise. 4) Sketches/ diagrams are to be complete.

1. A 50 kVA, 2200/220 V single phase transformer when tested gave the following results:
- OC test, measurement on LV side: 405 W, 5 A, 220 V  
SC test, measurement on HV side: 805 W, 20.2 A, 95 V
- 1A) Calculate the series and shunt parameters of the above transformer. [5 Marks]  
1B) Draw the circuit model of the transformer referred to HV and LV sides. Label all the parameters. [5 Marks]  
1C) Calculate the efficiency for the machine at full load, 0.85 power factor lag. [5 Marks]
2. A 20 kVA, 2000/200 V, single phase transformer has the following parameters:  
HV winding  $R_1 = 3 \Omega$   $X_1 = 5.3 \Omega$   
LV winding  $R_2 = 0.05 \Omega$   $X_2 = 0.05 \Omega$
- Find the following:
- 2A) Secondary terminal voltage at 0.707 pf leading when delivering full-load current with the primary voltage held fixed at 2 kV.  
2B) Voltage regulation at the above load.  
2C) Load pf corresponding to zero voltage regulation  
2D) Load pf corresponding to maximum voltage regulation [10 Marks]
3. A small industrial unit, considered as a balanced 3 phase load, draws power from the secondaries of a 2000/200 V, 60 kVA  $\Delta/\Delta$  transformer bank.
- Find:
- 3A) Rated line current available from the transformer bank  
3B) Rated phase current of the  $\Delta$ -secondaries  
3C) Primary phase current  
3D) Primary line current [5 Marks]
-

**BITS, PILANI – DUBAI CAMPUS**  
**FIRST SEMESTER 2012 – 2013**  
**EEE/INSTR/ ECE F211 ELECTRICAL MACHINES**  
**QUIZ 2 (CLOSED BOOK)**

**MAXIMUM MARKS: 10**  
**DATE: 19.11.12**

**SET A**

**WEIGHTAGE: 5 %**  
**DURATION: 20 MINUTES**

Name:	Id No:	Section:
-------	--------	----------

1. Mechanical power developed in a dc machine will be a maximum when armature emf  $E_a =$   
A)  $V/2$                       B)  $2V$                       C)  $V/8$                       D)  $V/3$                       **[1M]**
  
2. A dc motor armature is drawing 25 A, running at 1500 rpm. Its induced emf is 188 V. The gross mechanical power developed is \_\_\_\_\_ kW and the developed torque is \_\_\_\_\_ Nm. **[3 M]**
  
3. Field control is generally used to get speeds \_\_\_\_\_ rated speed. **[1M]**  
A) Below                      B) Above                      C) equal to                      D) None of the options
  
4. A dc series motor should not be run on light/ no-load, because **[1M]**  
A) It will draw a dangerously large current  
B) It will run at a dangerously high speed  
C) It will stall  
D) None of the above
  
5. The critical resistance in a dc shunt generator is **[1M]**  
A) The resistance of the field circuit  
B) The value of field circuit resistance below which the generator would fail to excite  
C) The value of field circuit resistance above which the generator would fail to excite  
D) The value of field circuit resistance for which the generator no-load voltage equals the rated voltage
  
6. When Hopkinson's test was done on two similar dc shunt machines, the following results were obtained: supply voltage = 250 V, Field current of motor = 2A, field current of generator = 2.5 A, armature current of generator = 60A, armature current of motor = 75 A, resistance of each armature circuit =  $0.2 \Omega$ , **[3 M]**

The stray losses ( $P_{\text{stray}}$ ) of each machine is equal to \_\_\_\_\_ W and the current taken from the supply is \_\_\_\_\_ A.

\*\*\*\*\*

**BITS, PILANI – DUBAI CAMPUS**  
**FIRST SEMESTER 2012 – 2013**  
**EEE/INSTR/ ECE F211 ELECTRICAL MACHINES**  
**QUIZ 1 (CLOSED BOOK)**

**MAXIMUM MARKS: 10**  
**DATE: 29.10.12**

**SET A**

**WEIGHTAGE: 5 %**  
**DURATION: 20 MINUTES**

Name:	Id No:	Section:
-------	--------	----------

1. The following is true in the case of OC and SC tests of transformer. [1M]
  - A) OC test is conducted from HV side and SC test from LV side
  - B) SC test is conducted from HV side and OC test from LV side
  - C) SC test is conducted from HV side with full voltage applied
  - D) OC test is conducted from HV side with full voltage applied
  
2. In a transformer, if the iron loss is 75 W and copper loss at rated current is 300 W, the maximum efficiency occurs at [1M]
  - A) full load
  - B) three fourth load
  - C) half load
  - D) quarter load
  
3. In a 20 kVA, 2000/200 V single phase transformer, the full load current at LV side is equal to \_\_\_\_\_ A. [1M]
  
4. The core of an ideal transformer is assumed to have permeability equal to \_\_\_\_\_ so that the magnetizing current needed to establish the requisite amount of flux is \_\_\_\_\_. [2M]
  
5. A 4-pole dc machine is lap-wound with 400 conductors. If the flux per pole is 20 mWb and speed is 1500 rpm, its armature induced emf is \_\_\_\_\_. [2M]
  
6. The value of field circuit resistance above which the dc generator would fail to excite is called as \_\_\_\_\_. [1M]
  
7. The two distinct classes of dc generator excitation are \_\_\_\_\_ excitation and \_\_\_\_\_ excitation. [2M]

\*\*\*\*\*