

Name.....

Roll No.....

BITS, Pilani-Dubai Campus  
Knowledge Village, Dubai

III Year (EEE&EI) 2003-2004

Comprehensive Exams

EEE UC371 (Electromechanical Energy Conversion)

Max Marks 60

Time 3 Hours

Answer any five Questions. Each question carries equal marks.

- Q1 a) Derive a relation for two transformers connected in parallel having unequal voltage ratio. (5)
- b) Two 110 V, single phase furnaces take loads of 500kW and 800 KW respectively at a power factor of 0.71 lagging and are supplied from 6600V, 3 phase mains through a Scott-connected transformer combination. Calculate current in the three phase line, neglecting transformer losses. Draw the phasor diagram. (7)
- Q2 a) Explain the phenomenon of armature reaction in a D.C Machine. (5)
- b) A D.C Motor is being operated from 300V mains. Its no load speed is 1200rpm. When fully loaded, it delivers a torque of 400 Nm and its speed drops to 1100rpm. Find its speed and power output when delivering the same torque if operated with an armature voltage of 600V. Excitation is assumed unchanged i.e the motor field is still excited at 300 V. (7)
- Q3 a) Sketch and explain the shape of a typical induction motor torque-slip characteristic curve. (5)
- b) A 3.3 kV, 20 pole, 50 Hz, 3-phase, star connected induction motor has a slip ring rotor of resistance of 0.025 ohm and standstill reactance of 0.28 ohm per phase. The motor has a speed of 294 rpm when full load torque is applied. Compute
- Slip at maximum torque and
  - The ratio of maximum to full load torque.
- Neglect stator impedance. (7)
- Q4 Explain with neat diagrams the following types of single phase induction motors. Also draw their Torque- Speed characteristics.
- Split phase windings
  - Capacitor – start run
  - Permanent split capacitor and capacitor start capacitor run motors
- (4x3)

Q5 a) Explain effects of varying excitation on armature current and power factor in a synchronous motor. Draw and explain V curves. (5)

b) A 1000 kVA, 6.6 Kv, 3 phase star connected synchronous generator has a synchronous reactance of 25 Ohm per Phase. It supplies full load current at 0.8 lagging P.F and a rated terminal voltage. Compute the terminal voltage for the same excitation when the generator supplies full load current at 0.8 leading pf. (7)

Q6 a) Discuss operating Characteristics and power angle characteristics of synchronous motor for generating mode and motoring mode. (5)

b) A 50 kw, 230 V D.C Shunt motor has an armature resistance of 0.1 ohms and a field resistance of 200 ohms. It runs on no load at a speed of 1400 rpm, drawing a current of 10A from the mains. When delivering a certain load, the motor draws a current of 200A from the mains. Find the speed at which it will run at this load and the torque developed. Assume that the armature reaction causes a reduction in the flux/pole of 4% of its no load value. (7)

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**Year 2003, Semester 2003-2004**

Test- 1

EEE UC 371 - EMEC

12<sup>th</sup> Oct 2003

Max Marks 20

Time: 45 Minutes

Answer all questions

Q 1 Derive an expression for the savings of copper in an auto-transformer as compared to an equivalent two winding transformer. Draw and explain the pharos diagram of an Auto transformer on load.  
(5+3)

Q2 Two Transformers A and B are connected in parallel to a load of  $(2+j1.5)$  ohm. The impedances in secondary are  $Z_a = (0.1+j0.6)$  Ohm and  $Z_b = (0.1+j0.6)$  Ohm. Their no load terminal voltages are  $E_a = 207 \angle 0^\circ$  and  $E_b = 205 \angle 0^\circ$  volts. Find the power output and power factor of each transformer.  
(6)

Q3 Two single phase furnaces working at 100 V are connected to 3300V, 3-phase mains through Scott connected transformers. Calculate the current in each line of the 3 phase mains when the power taken by each furnace is 400 kw at a power factor of 0.8 lagging. Neglect losses in the transformer.  
(6)

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## **Test II**

### **EEE UC371 (Electromechanical Energy Conversion)**

**Max Marks 20**

**Time 50 Minutes**

**Answer all Questions**

**Q1 An 8 pole, 3-phase 50 Hz induction motor is running at a speed of 710 rpm with an input power of 35 kw. The stator copper losses at this operating condition is known to be 1200 W while the rotational losses are 600 W. Find**

- a) The rotor Cu loss**
- b) The gross torque developed**
- c) The gross mechanical power developed**
- d) The net torque and**
- e) Mechanical power output**

**(10)**

**Q2 Sketch and explain the shape of a typical induction motor torque-speed characteristic curve.**

**(4)**

**Q3 A 4 pole three phase 50 Hz induction motor at standstill has 120V induced emf s across its star connected rotor terminals. The rotor resistance and standstill reactance per phase are 0.2 and 1 ohm respectively. Calculate the rotor speed when the rotor is drawing a current of 16A at a particular load. Also calculate the speed at which the torque is maximum and the corresponding value of rotor input.**

**(6)**

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**QUIZ**

**EEE UC371 (Electromechanical Energy Conversion)**

**Max Marks 10**

**Time 30 Minutes**

- Q1 The frequency of a voltage at the secondary of the transformer is  
e) Greater than that of primary  
f) **Equal to that of primary**  
g) None  
h) Less than that of primary
- Q2 An Ideal Transformer does not change  
e) Voltage  
f) Current  
g) **Power**  
h) None of these
- Q3 Power transformers are designed to have maximum efficiency around.....full load  
e) **nearly**  
f) 50% of  
g) 25% of  
h) 0% of
- Q4 Which of the following connection of transformer will give the highest secondary voltage?  
e) Delta primary, Delta secondary  
f) **Delta primary, Star secondary**  
g) Star primary, Star secondary  
h) Star primary, Delta secondary
- Q5 In Scott connection, the teaser transformer operates on 0.866 of its rated  
e) Impedance  
f) Current  
g) **Voltage**  
h) Power

Q6 In conversion of 3 phase to 2 phase supply with T-connection, the transformation ratio of the teaser will be .....times of that main transformer.

- a)  $\sqrt{3}$       b) 1.15      c) 0.866      d) unity

Q7 In parallel operation load sharing by transformers is according to

- e) **Per unit Impedance**  
f) Kva rating  
g) Kw rating  
h) Efficiency

Q8 A tap changer is used on a transformer for adjusting the ..... voltage.

- e) Primary  
f) **Secondary**  
g) Both primary and secondary  
h) None of the above

Q9 A d c generator having residual magnetism gives zero induced emf, the speed will be

- e) **Zero**  
f) Very small  
g) Rated one  
h) Any

Q10 At resistance less than critical resistance in the field circuit, the generator fails to excite  
True|False

Q11 In case of two transformers connected in parallel, their equivalent impedances are directly proportional to the KVA ratings.      True/False

Q12 Write one example ..... Where two phase supply is needed.

Q13 Three phase to two phase conversion is possible by

- e) Scott connections  
f) Open delta connection  
g) **Both ( a ) & ( b )**  
h) None

Q14 In a d c generator, demagnetization component of armature reaction causes

- e) **Reduction in generated emf.**  
f) Sparking trouble  
g) Increase in speed  
h) None

Q15 Compensating winding in a d.c machine is placed on

- e) Armature in slots  
f) Yoke in the inter-polar gap

g) **Yoke in the pole faces**

h) Partly in the armature slots and partly in the pole faces

Q16 The armature current in a d c shunt generator is given as  $(E_g + V)/R_a$  True/False

Q17 An ideal d c generator has a regulation of .....percent

- a) **Zero %**    b) 100%    c) 10%    d) 25%

Q18 When the supply terminals of a dc shunt motor are interchanged

- e) The motor will stop  
f) **The motor will run at its normal speed in the same direction as before**  
g) The direction of rotation will reverse  
h) The motor will run much faster in the same direction

Q 19 The output indicated on the name plate of any motor

- a) Gross power  
b) Power drawn in kva  
c) Power drawn in kw  
d) **Output power at the shaft**

Q20 Define critical speed

Q21 Ward Leonard Control provides speed control

- e) In one direction only  
f) **In both direction**  
g) Above rated speed  
h) Below rated speed

Q22 Draw internal/external load characteristics of dc shunt generator

Q23 Write two applications of each d c shunt/series/compound motors

Q24 Write two applications of each d c shunt/series/compound Generators

Q25 How does hysteresis and eddy current losses depend upon the motor speed

Q26 Compensating windings in d c motors are shunt excited to cancel armature reaction at any load  
True/False

Q27 What is braking by plugging?

Q28 Write any two limitations of Hopkinson's test

Q29 The direction of emf generated in the armature in case of dc motor is decided by Fleming's right hand rule.  
True/False

Q30 Dc series motors are constant speed motor  
True/False