

**II B.Tech I Semester Supplementary Examinations, February 2008**  
**ELECTRICAL ENGINEERING**  
 ( Common to Mechanical Engineering, Chemical Engineering, Mechatronics  
 and Production Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions  
 All Questions carry equal marks

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1. (a) Find the voltage across the  $2\Omega$  resistor shown in the figure1(b)ii.
- (b) Two coils, A of 12,500 turns and B of 16,000 turns lie in parallel planes so that 60% of flux produced in A links coil B. It is found that a current of 5A in A produces a flux of 0.6mWb while the same current in B produces 0.8mWb. Determine
  - i. mutual inductance and
  - ii. coupling coefficient.

[8+8]

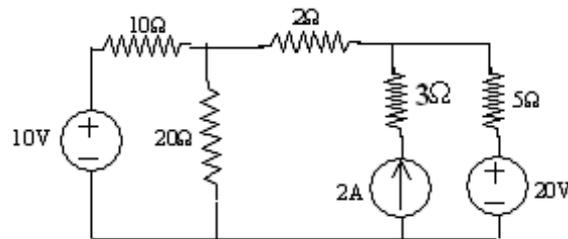


Figure 1(b)ii

2. (a) Determine the effective value of the current  $i(t) = 5 + 4 \cos 314t + 3 \sin 314t$ .
- (b) A  $50\Omega$  resistor is connected in series with an inductor having internal resistance, a capacitor and 100V variable frequency supply as shown in the figure2b. At a frequency of 200Hz, a maximum current of 0.7A flows through the circuit and voltage across the capacitor is 200V. Determine the circuit constants.

[4+12]

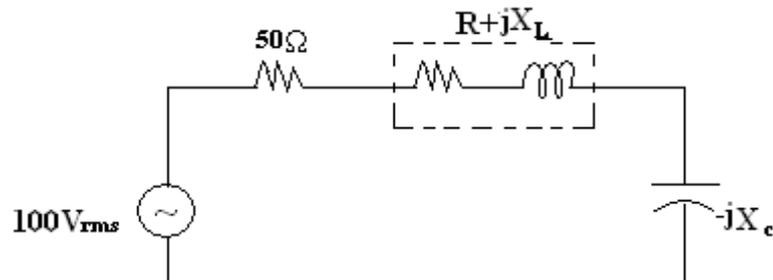


Figure 2b

3. In a dc-machine the total iron loss is 8kw at its rated speed if the excitation remains the same, but speed is reduced by 25% , the total iron loss is found to be 5kw. Calculate the hysteresis and eddy current losses at

- (a) full speed  
(b) half the rated speed. [16]
4. (a) Explain the working of a 3-point starter with a circuit. Diagram for a D.C.Shunt motor  
(b) A dc shunt machine develops an O,C emf of 250V at 1500rpm. Find its Torque and its mechanical power developed for armature current of 50A. State the simplifying assumption. [8+8]
5. (a) Draw the phasor diagram of a transformer on  
i. no-load  
ii. full-load  
with inductive load and explain  
(b) A Single phase transformer has 500 turns in the primary and 1200 turns in the secondary .The cross-sectional area of the core is 80 sq.cm. If the primary winding is connected to a 50 hz supply at 500V. Calculate  
i. peak flux density  
ii. voltage induced in the secondary. [8+8]
6. (a) Explain the operation of slip ring induction motor.  
(b) A 3- $\Phi$ , 4-pole,1440rpm,50Hz Induction motor has star connected rotor winding, having a resistance of  $0.2\Omega$ /phase and stand still leakage of  $1\ \Omega$ /phase . when the stator is energized at rated voltage and frequency, the rotor induced emf at stand still is 120V/phase.  
i. calculate the rotor current , rotor power factor and torque both at starting and at full load and compare the results.  
ii. If the external resistance of  $1\Omega$ /phase is inserted in rotor circuit, calculate rotor current rotor power factor and torque at the time of starting.[6+10]
7. (a) Derive an expression for the voltage induced in an alternator phase consisting of a number of full pitch coils jointed in series. Assume the air gap flux to have sinusoidal distribution.  
(b) Calculate the voltage induced per phase in a 3-phase, 50 Hz, alternator having a flux per pole of 0.1515 wb. The number of conductors in series is 360. Assume full pitch coil with a distribution factor of 0.96. [9+7]
8. Voltage of 80.0V is applied to a circuit comprising two resistors of resistance 105 ohms and 55ohms respectively. The voltage across the 55 ohm resistor is to be measured by a voltmeter of internal resistance 100 ohm / V. Given that the meter is set to a scale of 0-50V.Determine the voltage indicated. [16]

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1. (a) Explain Ohm's law, KCL and KVL and their basis with suitable examples.
- (b) Find the equivalent resistance existing between terminals a and b shown in the figure 1b. [8+8]

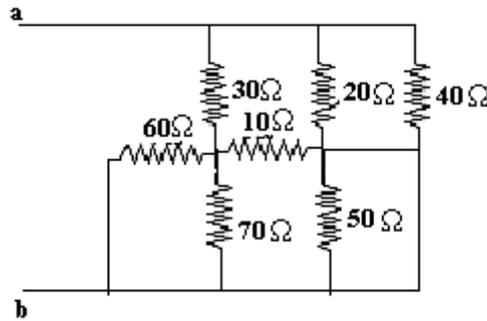


Figure 1b

2. (a) Obtain the expression for frequency at which the voltage across the inductance becomes a maximum in a series RLC circuit. Explain what is meant by voltage magnification factor.
- (b) For the series parallel circuit shown, determine (figure2(b)iii)
  - i. the total impedance between the terminals a,b and state whether it is inductive or capacitive
  - ii. the voltage across the parallel branch, and
  - iii. the phase angle. [8+8]

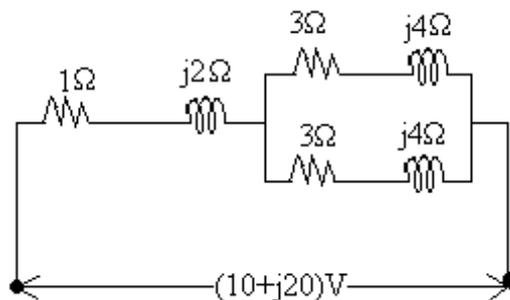


Figure 2(b)iii

3. In a dc-machine the total iron loss is 8kw at its rated speed if the excitation remains the same, but speed is reduced by 25% , the total iron loss is found to be 5kw. Calculate the hysteresis and eddy current losses at

- (a) full speed  
 (b) half the rated speed. [16]
4. (a) Why is starter is necessary for D.C.Motor  
 (b) A 200V shunt motor has an armature resistance of  $0.2\Omega$ . The starting armature current must not exceed 50A. If the number of sections are 5, calculate the values of resistance steps to be used in the starter. [8+8]
5. A 300KVA,11000/440V,50 hz 1- $\Phi$  transformer Give the following results.
- |          |      |       |       |          |
|----------|------|-------|-------|----------|
| o.c test | 120V | 21.1A | 1.3KW | L.V.side |
| s.c test | 600V | 15A   | 2.8KW | H.V.side |
- From the above tests calculate the efficiency and regulation for full load at 0.8 p.f lagging. [16]
6. (a) Derive the starting torque equation of an induction motor.  
 (b) In a 3- $\Phi$  induction motor, the stator reactance equals rotor reactance at stand-still ,while each resistance is one-fourth of its value. If motor develops a torque of 220N-m at 3% slip, determine
- i. starting torque
  - ii. maximum torque. [6+10]
7. (a) Sketch and explain the open-circuit and short-circuit characteristics of a Synchronous machine  
 (b) A 50 Hz, 3-phase, star-connected alternator which generates 10,000 V between lines on opens-circuit, has a flux per pole of  $15 \times 10^{-2}$  wb. If the distribution factor of the full-pitch coil is 0.96, find the number of armature conductors in series per phase. [8+8]
8. (a) Explain the Advantages & Disadvantages of MI Instruments  
 (b) The deflecting torque of an ammeter varies as the square of the current passing through it . If a current of 5A produces a deflection of  $90^\circ$  .Find the value of current required for a deflection of  $30^\circ$  . if the instrument is
- i. Spring control
  - ii. Gravity control. [8+8]

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1. (a) Derive the Faraday's law of electromagnetic induction from the first principle.  
(b) A 100 turn coil is wound on a magnetic bobbin, the average diameter of the coil can be taken to be 10mm. Find the emf induced in the coil when the flux density B is changed from  $5\text{mWb/m}^2$  to  $0.1\text{ Wb/m}^2$  in 35n Sec.  
(c) Four 60W, 110V bulbs are to be operated from a 230V source. Determine the value of the resistance connected in series with the line so that the voltage across the bulbs does not exceed 110V. [4+6+6]
2. (a) A series R C circuit is excited by sinusoidal voltage  $I = I_m \sin \omega t$ . Find the expression for impedance using phasor diagram.  
(b) A voltage  $v(t) = 10 \sin \omega t$  is applied to the series RLC circuit. At the resonant frequency of the circuit, the maximum voltage across the capacitor is found to be 500V. Moreover, the bandwidth is known to be 400rad/sec, and the impedance at resonance is  $100\Omega$ . Find the resonant frequency. Also find the values of L and C of the circuit. [4+12]
3. (a) What is the principle of operation of a d.c. generator, explain with help of a diagram?  
(b) A 4-pole generator having wave wend armature winding has 51 slots each slot contains 20 conductors. What will be the voltages generated in the machine when driven at 1.500 r.p.m assuming the flux per to be 7.0m wb? [16]
4. (a) Deduce the equation for the emf induced in a D.C machine  
(b) A 8-pole 220V series motor is wave connected. There are 200 slots and each slot has 4 conductors the flux per pole is  $1.5 \times 10^{-2}$  Wb. When the motor is taking 60A. The field resistance is  $0.03\Omega$ , and armature resistance is  $0.1\Omega$ , and the iron, frictional loss is 0.1KW. Calculate
  - i. speed
  - ii. BHP
  - iii. Shaft torque. [6+10]
5. (a) Explain the o.c and s.c tests on the transformer and hence explain the evaluation of equivalent circuit from it  
(b) A 40 KVA transformer with a ratio of 2000/250V has a primary resistance of  $1.15\Omega$  secondary resistance of  $0.0155\Omega$ . Calculate

- i. the total resistance in terms of secondary windings,
  - ii. the total resistance on full load and
  - iii. the total copper loss on full load. [8+8]
6. (a) State the effects of increasing rotor resistance on starting current, starting torque, maximum torque and full-load slip of an induction motor?
- (b) A 100KW, 3- $\Phi$ , 420V, 6-pole, 50Hz wound rotor Induction motor, with its rotor winding short circuited, has a full-load slip of 0.04 and slip at maximum torque of 0.2 when operating at rated voltage and frequency. Find
- i. maximum torque
  - ii. starting torque. If rotor resistance is doubled by adding external series resistance. Determine
  - iii. slip at full-load output
  - iv. full-load torque
  - v. slip at maximum torque. [6+10]
7. (a) State clearly what is meant by the synchronous reactance of an alternator.
- (b) A 500 V, 50 k VA single phase alternator has an effective resistance of 0.2  $\Omega$ . On short circuit, a field current of 10 A circulates in the armature a current of 200 amperes. On open circuit the same field current generates an emf of 450 V. Determine
- i. the synchronous impedance,
  - ii. synchronous reactance and
  - iii. regulation at full load, 0.8 pf lagging. [6+10]
8. (a) Explain the errors and compensations involved in a MI Instruments
- (b) Find the multiplying power of shunt of 200 $\Omega$  resistance used with a galvanometer of 1000 $\Omega$  resistance . Determine the value of shunt resistance to give a multiplying power of 50. [8+8]

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1. (a) State Faradays laws of electromagnetic induction. What are statically and dynamically induced emfs?
- (b) Determine the current supplied by the 2V battery shown in the figure1b.

[8+8]

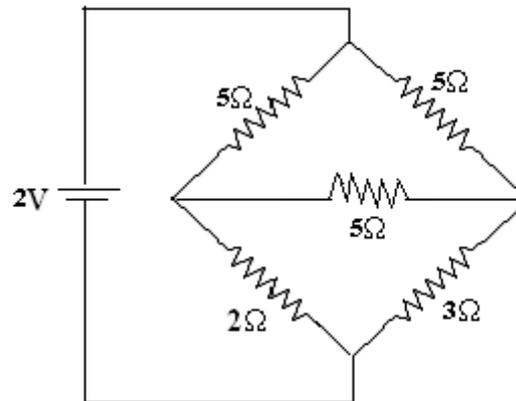


Figure 1b

2. (a) Define the following terms
  - i. Resonance frequency
  - ii. Band width
  - iii. Q-factor
  - iv. Half power frequencies
- (b) A series circuit of two pure elements has the following applied voltage and current.  $v(t) = 15\cos(200t - 30^\circ)\text{V}$ ;  $i(t) = 8.5\cos(200t + 15^\circ)\text{A}$ . Find the elements comprising the circuit. [8+8]
3. In a dc-machine the total iron loss is 8kw at its rated speed if the excitation remains the same, but speed is reduced by 25% , the total iron loss is found to be 5kw. Calculate the hysteresis and eddy current losses at
  - (a) full speed
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- i. speed
  - ii. BHP
  - iii. Shaft torque. [6+10]
5. (a) Explain the operation of transformers on load
- (b) A 10KVA ,500/250V , single phase transformer has its maximum efficiency of 94% when delivering 90% of its rated output at P.F Estimate its efficiency when delivering its full load output at P.F at 0.8 lagging. [6+10]
6. (a) Explain the operation of slip ring induction motor.
- (b) A  $3-\Phi$ , 4-pole,1440rpm,50Hz Induction motor has star connected rotor winding, having a resistance of  $0.2\Omega$ /phase and stand still leakage of  $1 \Omega$ /phase . when the stator is energized at rated voltage and frequency, the rotor induced emf at stand still is 120V/phase.
- i. calculate the rotor current , rotor power factor and torque both at starting and at full load and compare the results.
  - ii. If the external resistance of  $1\Omega$ /phase is inserted in rotor circuit, calculate rotor current rotor power factor and torque at the time of starting.[6+10]
7. (a) Differentiate between turbo-alternator and salient pole alternator.
- (b) A 3-phase, 50 Hz alternator has 72 slots on stator and each slot is having 10 conductors. The flux per pole is 0.1 wb. Assuming full pitch coils and a winding distribution factor of 0.96, calculate the rms value of voltage induced per phase. [8+8]
8. Voltage of 80.0V is applied to a circuit comprising two resistors of resistance 105 ohms and 55ohms respectively. The voltage across the 55 ohm resistor is to be measured by a voltmeter of internal resistance 100 ohm / V. Given that the meter is set to a scale of 0-50V.Determine the voltage indicated. [16]

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