B.Tech II Year - I Semester Examinations, May-June, 2012
ELECTRICAL ENGINEERING
(COMMON TO CHEM, MMT)

Time: 3 hours   **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1.a) Find the total inductance of three series connected coupled coils shown below in Figure 1.
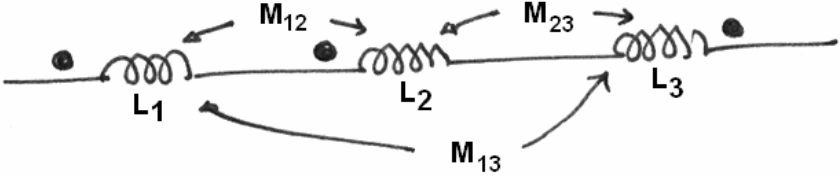

Figure.1

$L_1 = 1H$ $M_{12} = 3H$
$L_2 = 5H$ $M_{23} = 5H$
$L_3 = 8H$ $M_{13} = 1H$

  b) What value of R in the circuit shown below in Figure 2, would cause the current source to deliver 800 mW to the Resisters?   [8+7]
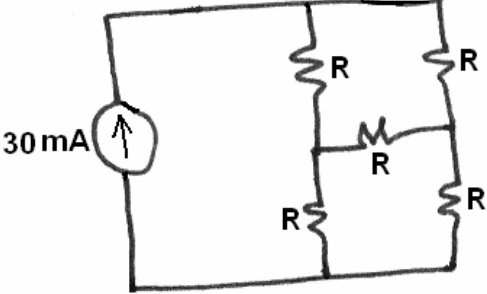

Figure.2

2.a) Find the average and RMS values of the wave form shown below in Figure.3. Also calculate its form factor.
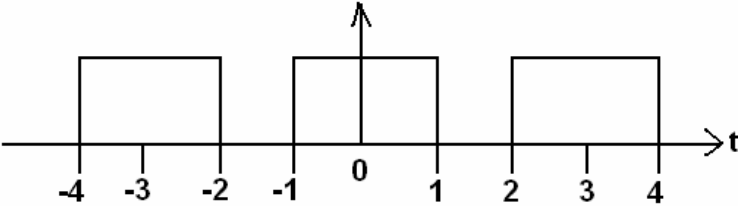

Figure.3

  b) A balanced Δ - connected load having an impedance of $(20 – j15)\Omega$ is connected to a Δ - connected, positive sequence generator having $V_{ab} = 330\angle 0^0 V$. Calculate the phase currents of the load and the line circuits.   [8+7]

3.a) Obtain the critical resistance and critical speed of a DC machine from the open circuit characteristics.
  b) Derive the emf equation of a DC generator.   [7+8]

4.a) A 230V DC shunt motor runs at 900 rpm at no load, while taking an armature current of 2A. The armature resistance is 0.5Ω. At rated load and rated voltage the armature current is 20A. Find the speed regulation if a 20Ω resistance is in series and 3Ω resistance is in parallel with it.
  b) What are the different methods of speed control of a DC shunt motor? Explain with advantages and disadvantages.   [8+7]

5.a) Explain the method of determination of no load losses of a single phase transformer.

b) A 600KVA 1-ϕ transformer has an efficiency of 92% both at full load and half load at unity p.f. Determine its efficiency at 60% of full load at 0.8 p.f. lagging.

[7+8]

6.a) Derive a general expression for torque developed in a 3-ϕ induction motor.

b) Sketch and explain the torque – slip characteristics of a three phase induction motor. [8+7]

7.a) Derive the formula for computing breadth factor and coil span factor.

b) Explain voltage regulation calculation of an alternator using synchronous impedance method. [7+8]

8. Explain the construction and working of a permanent magnet moving coil instrument. Also mention its advantages and disadvantages. [15]

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1.a)   Derive expressions for energy stored in inductor and capacitor.

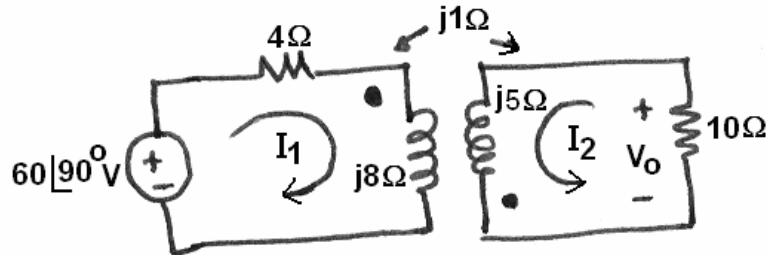   b)   Solve for I_1, I_2 and V_O for the circuit shown in Figure.1.   [7+8]

Figure.1

2.a)   Three impedances of each $(5+ j12)\Omega$, connected in delta are connected to a 220V, 3-ϕ, 50 Hz supply. Calculate line currents and complex power.

   b)   For the circuit diagram shown in Figure.2, calculate current in each branch, total input current and the power delivered to the circuit.   [7+8]
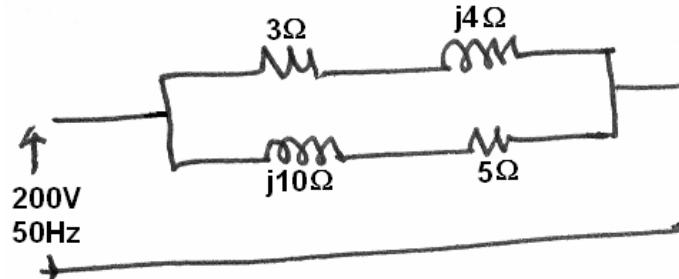

Figure.2

3.a)   A 4 pole DC generator has a useful flux per pole of 0.07 Wb. The armature has 400 lap connected conductors each of resistance 0.002 Ω and is rotating at a speed of 900 rpm. If the armature current is 50A, calculate the terminal voltage.

   b)   Define and explain the critical field circuit resistance and critical speed of a DC shunt generator. How these can be calculated?   [8+7]

4.a)   Derive an expression for the torque developed in a DC motor.

   b)   A 230V DC shunt motor has an armature resistance of 0.4Ω. The starting armature current must not exceed 45A. If the number of sections are 5, calculate the values of resistance steps to be used in the starter.   [6+9]

5.a)   Explain the working principle of 1-ϕ transformer using vector diagrams at no-load and full load for lagging and leading power factors.

   b)   Calculate i) full load efficiency at unity p.f.
         ii) The voltage at the secondary terminals when supplying full load secondary current at 0.8 p.f. lagging for a 4KVA, 200/400V, 50 Hz, 1-ϕ transformer, of which following are the results.

OC Test: 200V,   0.8A,   70 W (LV side)
SC Test: 17.5V,   9A,   50W (HV side).   [7+8]

6.a) Write about operating characteristics of an induction motor.
   b) Draw the equivalent circuit of 3-ϕ induction motor.   [7+8]

7. Explain in detail how the regulation of an alternator can be determined by using synchronous impedance method.   [15]

8. Explain the construction and working of a permanent magnet moving iron instrument. Mention its advantages and disadvantages.   [15]

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1.a)   Determine V_O and i in the circuit shown below in Figure.1.
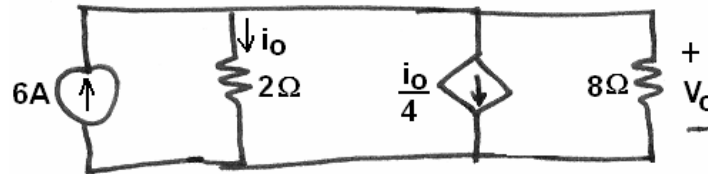

Figure.1

b)   The current through a $100\,\mu F$ capacitor is $i(t) = 50\,Sin\,120\,\Pi\,t$ mA. Calculate the voltage across it at t = 5 sec and t = 5 msec. Take v(o) = 0.   [8+7]

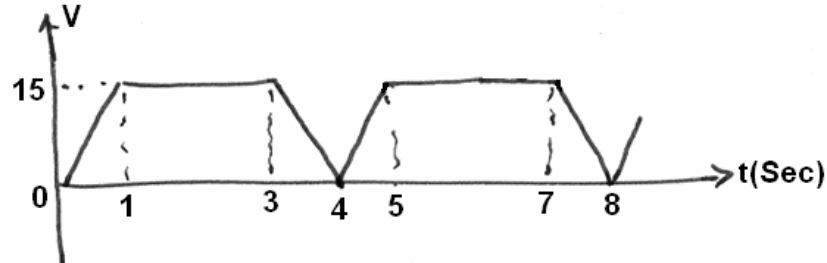2.a)   Obtain RMS and average value of the wave form shown below in figure 2.

Figure.2

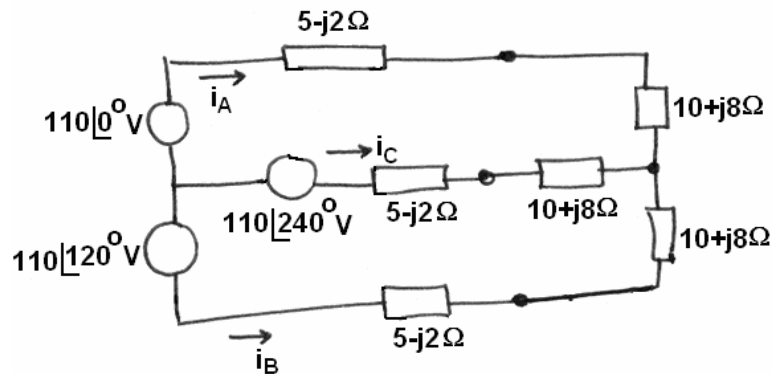b)   Find the currents in the three – wire Y – Y system shown below in Figure.3.

[7+8]

Figure.3

3.a)   Derive the expression for generated emf in a DC generator.
  b)   A dc series generator is running at 1000rpm and is supplying a load of 10 kW at 250V. The speed of the generator is increased to 1400 rpm and load is increased to 14 kW. The sum of armature and field resistance is $0.4\,\Omega$. Find new value of armature current and terminal voltage. Neglect armature reaction.   [7+8]

4.a)   Discuss the various operating characteristics and performance characteristics of DC shunt and series motors.
  b)   Explain the different speed control method of DC shunt motor and mention their advantages and disadvantages.   [7+8]

5.a) Draw the equivalent circuit of a transformer referred to primary representing the different elements.

b) A 200KVA transformer has an efficiency of 98% at full load. If the maximum efficiency occurs at $\frac{3}{4}$ of full load, calculate the efficiency at half load. Assume negligible magnetizing current and pf 0.8 at all loads. [7+8]

6.a) Explain the principle and operation of three phase induction motor.

b) A 3-ϕ, 400V, 50 Hz induction motor takes power input of 35 kW at its full speed of 890rpm. Calculate
i) Slip for 4 poles and 6 poles.
ii) Frequency of rotor emf for 4 poles and 6 poles. [7+8]

7.a) Derive emf equation of an alternator.

b) A 4 – pole, 50 Hz, 3-ϕ star connected alternator has a single layer winding in 36 slots with 30 conductors per slot. The flux per pole is 0.05 Wb and winding is full pitched. Find synchronous speed and line voltage on no load. [7+8]

8.a) Explain the essential features of inducting instruments.

b) Why can PMMC instruments not be used for ac measurement? [9+6]

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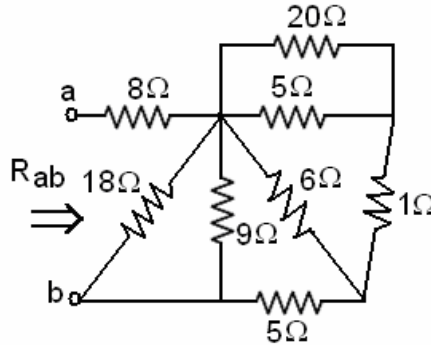1.a) Find R_{ab} in the circuit shown below in Figure.1.

Figure.1

b) Find the current through 1 mH inductor if the voltage across it is.

$$\upsilon(t) = \begin{cases} 30t^2, & t > 0 \\ 0, & t < 0 \end{cases}$$

Also find the energy stored at t = 5sec.   [7+8]

2.a) Calculate the line current and circuit power factor for the RLC circuit shown in figure 2.
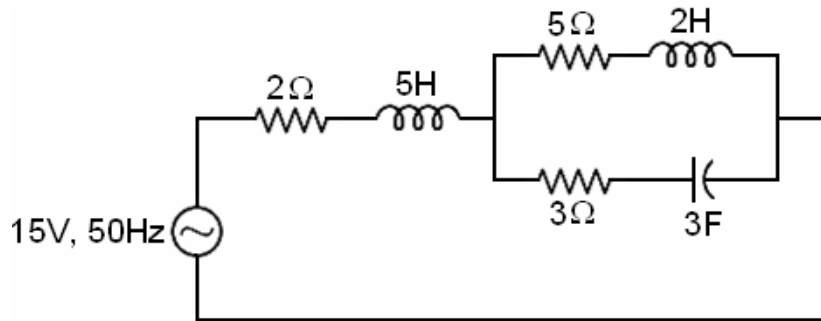

Figure.2

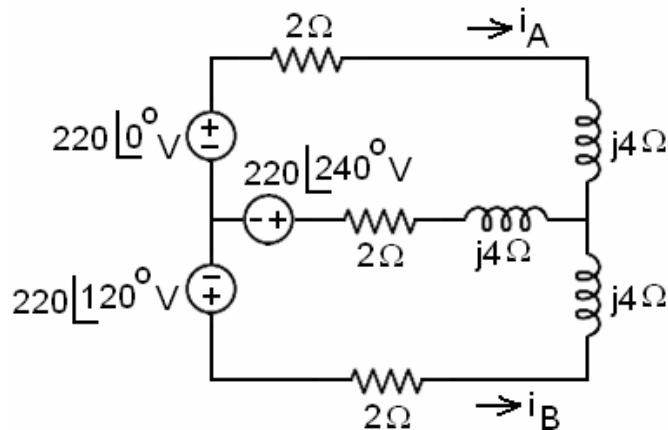b) For the circuit shown below in figure 3, determine the currents i_A and i_B.   [7+8]

Figure.3

7

3.a) Describe with suitable sketches the construction details of the various parts of DC machine and their functions.

b) Explain the self excitation process in DC machine. Mention the cause of failure of voltage building and suggest suitable remedies. [7+8]

4.a) Explain the construction and operation of a three point starter for DC motors, with the aid of a neat diagram.

b) Explain the various speed control methods of DC shunt motors with the help of neat circuits and characteristic curves. [8+7]

5.a) Derive the emf equation of a transformer.

b) A 200/100V, 50Hz, 3KVA, 1-ϕ transformer gives the following test results:

OC test on LV side: 100V, 0.35A, 35W
SC test on HV side: 12V, 15A, 80W.
Find efficiency and regulation at half load and full load for 0.8pf leading. [6+9]

6.a) Derive an expression for the torque developed by a 3-ϕ induction motor.

b) Draw and explain the torque – slip characteristics of 3-ϕ induction motor. [8+7]

7.a) Derive the emf equation of an alternator.

b) Draw the phasor diagram of alternator at lagging and leading power factor. [9+6]

8. Describe the constructional details and working of a moving iron attraction type meter. [15]

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