

II B.Tech I Semester Supplementary Examinations, February 2007
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

1. (a) Explain Faraday's laws of electromagnetic induction and Mutual Inductance.
- (b) A three wire dc line supplying a resistive bank of loads is shown in the figure1. If the voltage between the terminals a and c is 240V, determine
 - i. the voltage between a and b .
 - ii. with line a open, determine the resistance between the terminals bc . [6+10]

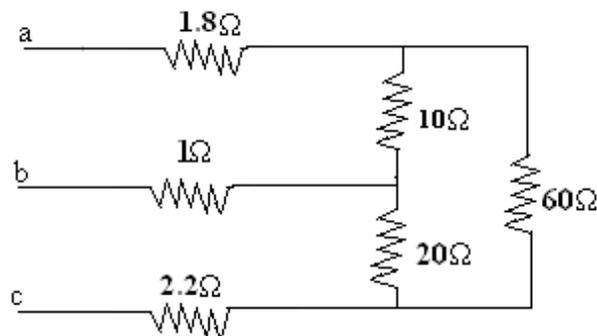


Figure 1:

2. (a) Explain how a sinusoidal quantity can be represented by a phasor
- (b) In the circuit shown, the current is at its maximum value, when the capacitor value is $20\ \mu\text{F}$ and 0.707 times its maximum value with $C = 30\ \mu\text{F}$. Find the quality factor Q at $\omega = 500\text{rad/sec}$, and the circuit constants (figure2). [8+8]

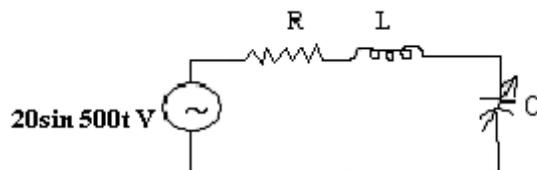


Figure 2:

3. Explain the types of d.c. generators with the help of diagrams?

[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) 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 1.15Ω secondary resistance of 0.0155Ω . 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) Explain the principle of working a three phase induction motor.
- (b) A 3- Φ , 600V, 12-pole, 50Hz star connected Induction motor has rotor resistance stand still reactance of 0.03 and 0.5Ω per phase respectively. Calculate
- i. speed at full load torque to maximum torque
 - ii. ratio of full load torque to maximum torque if full-load speed is 495 rpm. [8+8]
7. (a) Compare salient pole and non salient pole type Synchronous machines
- (b) The stator of a 3-phase, 16-pole Alternator has 144 slots and there are 4 conductors per slot connected in two layers and the conductors of each phase are connected in series. If the speed of the Alternator is 375 rpm, calculate the emf induced per phase. Resultant flux in the air-gap is 0.05 webers per pole sinusoidally distributed. Assume the coil span as 150 degrees electrical. [6+10]
8. (a) Explain the construction and principle Operation of PMMC Instruments with neat sketch
- (b) Derive the Torque equation for the PMMC Instruments. [8+8]

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- A transformer has primary winding 1250 turns and the secondary has 740 turns. The length of magnetic path can be taken as 27.5 cm and the cross sectional area of the core is 5.5cm^2 . Assuming $\mu_r = 750$, find the self inductance of primary and secondary windings separately and the mutual inductance between them.
 - For the circuit shown in the figure 1 calculate the potential of points A, B, C and E with respect to point D. Find also the value of voltage source V_1 . [8+8]

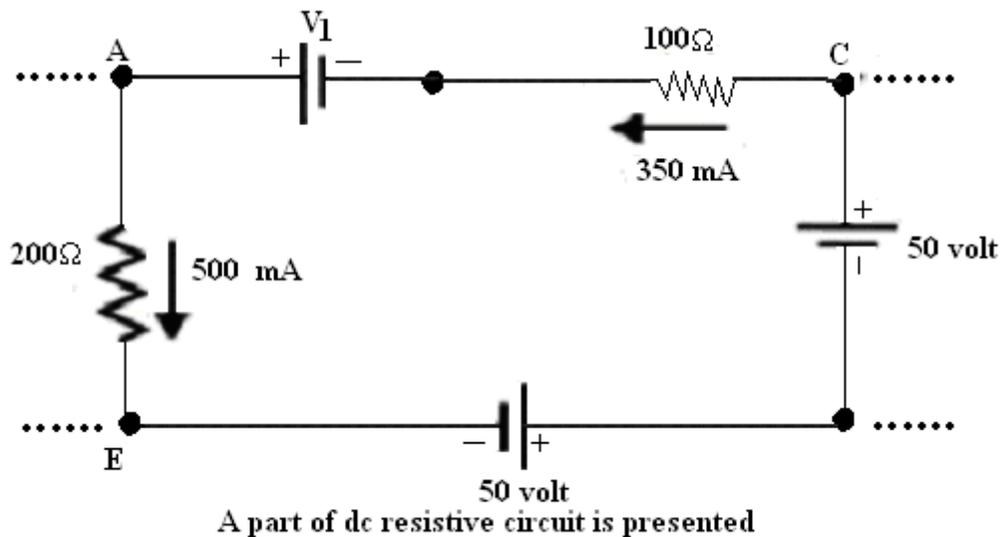


Figure 1:

- Show that in a series RLC circuit, the resonant frequency is geometric mean of half power frequencies.
 - A balanced 3-phase, star connected load of $(4+j3)\ \Omega/\text{phase}$ is connected to a balanced 3-phase 400V supply. The phase current is 12A. Find total active power, reactive power and total apparent power. [8+8]
- In a 120V compound generator, the resistance of armature shunt and series winding are $0.06\ \Omega$, $25\ \Omega$ & $0.04\ \Omega$ respectively. The load current is 100A at 120V find the induced emf and the armature current when the machine is connected as

- (a) long shunt &
(b) short shunt. How will the ampere turns of the series field be changed in
(c) if divertes of 0.1 be connected in parallel with the series field winding? Neglect brush contact drop and ignore armature reaction? [16]
4. (a) Why is starter is necessary for D.C.Motor
(b) A 200V shunt motor has an armature resistance of 0.2Ω . 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) what are the various losses in transformer explain
(b) A 40 KVA transformer with a ratio of 2000/250V has a primary resistance of 1.15Ω secondary resistance of 0.0155Ω . 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. [6+10]
6. (a) Explain the principle of working a three phase induction motor.
(b) A 3- Φ , 600V, 12-pole, 50Hz star connected Induction motor has rotor resistance stand still reactance of 0.03 and 0.5Ω per phase respectively. Calculate
i. speed at full load torque to maximum torque
ii. ratio of full load torque to maximum torque if full-load speed is 495 rpm. [8+8]
7. (a) Write the advantages of stationary armature of stationary Armature and rotating field in an Alternator
(b) From the following test results, determine the voltage regulation of a 2000-V, I-phase alternator delivering a current of 100 A at
i. unity p.f.
ii. 0.8 leading p.f. and
iii. 0.71 lagging p.f. [6+10]
8. (a) Why is spring control to be preferred to gravity control in an electrical
(b) Explain different types of damping Torques in an Indicating instruments. [8+8]

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1. (a) Derive the relation between the self, mutual inductances and coefficient of coupling.
- (b) What is the voltage across A and E terminals in the circuit shown in the figure1.

[6+10]

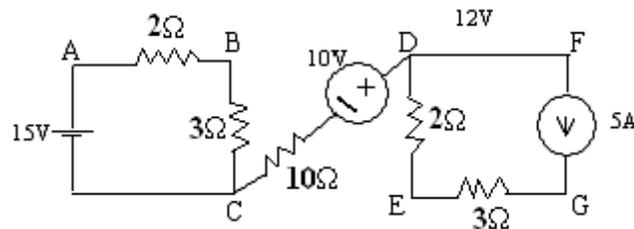


Figure 1:

2. (a) Derive the expression for $i(t)$ for R L series circuit when excited by a sinusoidal source.
- (b) Find the average and RMS values of the half-wave rectified sine wave shown in the figure2.

[8+8]

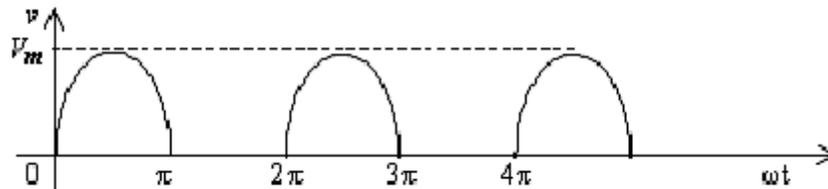


Figure 2:

3. Explain different parts of a d.c generator? [16]
4. (a) What are the various losses in a D.C.Machine and explain
- (b) A 250V,4-pole wave wound D.C series motor has 782 conductors on its armature. It has armature and field resistance of 0.75Ω . The motor takes a current of 40A. Determine the speed and torque developed if it has a flux per pole is 25mwb. [8+8]

5. (a) Derive the emf equation of a $1-\Phi$ transformer and draw the no-load phasor diagram
- (b) A $1-\Phi$ transformer has 360 turns on the primary and 180 turns on the secondary. The respective resistance are 0.233Ω AND 0.067Ω . Calculate the equivalent resistance of
- i. the primary in terms of secondary windings
 - ii. the secondary in terms of primary windings and
 - iii. the total resistance of the transformer in terms of primary. [6+10]
6. (a) Derive the torque equation of an induction motor.
- (b) A 6 pole, 50Hz squirrel cage induction motors run on load at a shaft speed of 970rpm calculate
- i. % slip
 - ii. The frequency of induced current in the rotor. [6+10]
7. (a) Derive an emf equation of alternators
- (b) A 4-pole, 50 Hz star-connected alternator has a flux per pole of 0.12 Wb. It has 4 slots per pole per phase, conductors per slot being 4. If the winding coil span is 150° , find the emf. [8+8]
8. (a) Explain why the MI scale is not uniform
- (b) A Moving Iron voltmeter in which full scale deflection is given by 100V, has a coil of 10000 turns and a resistance 2000. Calculate the number of turns required on the coil of the instrument is converted for use as an ammeter reading 20A full scale deflection. [8+8]

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- State and Explain Faraday's laws of electromagnetic induction. Distinguish between self inductance and mutual induced voltage.
 - Determine the resistance across the terminals ab of the interconnected resistors shown in the figure1. [8+8]

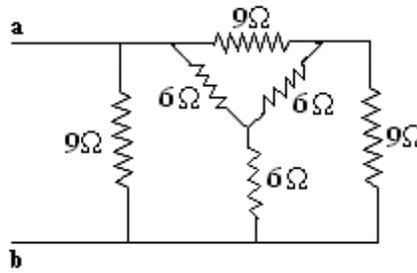


Figure 1:

- A resistor having a resistance of 10Ω and an unknown capacitor are in series. The voltage across the resistor is $v_R(t) = 50\sin(1000t + 45^\circ)V$. If the current leads the applied voltage by 60° what is the unknown capacitance?
 - A balanced 3-phase, star connected load of $(8+j6)\Omega$ /phase is connected to a 3-phase 230V supply. Find the line current, power factor, real power, reactive volt-amps and total volt-amps. [6+10]
- Determine the power output of a d.c. armature having 1,152 lap-connected conductors carrying 150A and rotating at 300 rpm in a 12-pole field the flux per pole is 60mwb?
 - A 440V d.c. shunt generator has an armature resistance of 0.25Ω and the resistance of the shunt field is 220Ω while delivering a load current of 50A, if has a terminal voltage of 440V. Determine the generated emf and power developed? [16]
- What is the significance of the back emf of a D.C.Motor
 - Deduce the condition for maximum power for a D.C.Motor
 - A 250V D.C.Shunt Motor takes 41A at full load. Resistance of Motor armature and shunt field windings are 0.1Ω and 250Ω respectively. Find the back emf, if

working as generator and supplying 41A to load at terminal voltage of 250V.
[4+6+6]

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 3- Φ , squirrel cage Induction motor has a rotor starting current of 6 times of its full-load value. The motor has full-load slip of 5%.Determine
(a) starting torque in terms of full load torque.
(b) slip at maximum torque
(c) Maximum torque in terms of full-load torque. [16]
7. (a) Define distribution factor and derive an expression for it in terms of the number of slots per pole per phase and the slot pitch in electrical degrees.
(b) A 3-phase 10-pole star-connected alternator runs at 720 rpm. It has 120 stator slots with 10 conductors per slot. If the flux per pole is 0.056 Wb, determine the phase an line induced emf. [8+8]
8. (a) Define the following:
i. Absolute Instruments
ii. secondary Instruments.
- (b) A PMMC instrument with an internal resistance of 730Ω has a full scale current of 5mA .It is to be converted into a multi range ammeter for ranges 1A, 5A, 25A and 125A using individual shunts for each range .Calculate the value of the Individual shunts. [4+12]
