SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
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QUESTION BANK (DESCRIPTIVE)

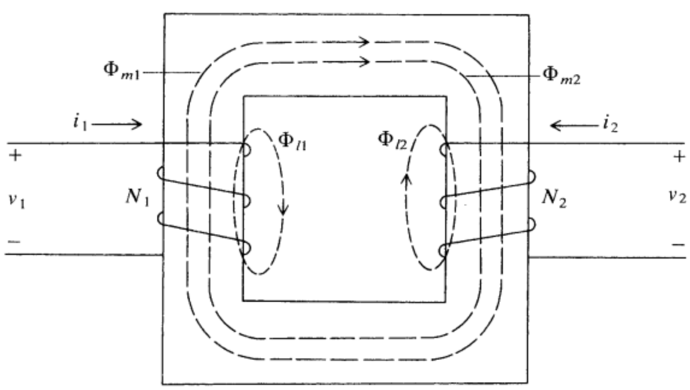
Subject with Code: MACHINE MODELLING & ANALYSIS

Course & Branch: **M.TECH. IN POWER ELECTRONICS**

Year &Sem: I-M.Tech & I-Sem **Regulation:** R25

UNIT –I

BASIC PRINCIPLES AND ANALYSIS OF DC MACHINES

1	Derive the expressions for flux linkages λ_1 and λ_2 of two coupled coils in a linear magnetic circuit.	[L2][CO1]	[10M]
2	Obtain the equivalent circuit of a two coupled coils in a linear magnetic circuit with reference to coil1.	[L2][CO1]	[10M]
3	Let us assume that when coil 2 of the two-winding transformer shown in figure below is open-circuited, the power input to coil 2 is 12 W with an applied voltage is 100 V (rms) at 60 Hz and the current is 1 A (rms). When coil 2 is short-circuited, the current flowing in coil 1 is 1 A when the applied voltage is 30 V at 60 Hz. The power during this test is 22 W. If we assume $L_{l1} = L'_{l2}$, Derive an approximate equivalent T circuit from these measurements with coil 1 selected as the reference coil. 	[L3][CO1]	[10M]
4	Considering a two pole three phase Y connected salient pole synchronous machine, plot the air ga mmf waveform of as winding with the assumption that MMF(0) is zero.	[L3][CO1]	[10M]
5	Derive the voltage equations of a two pole three phase Y connected salient pole synchronous machine.	[L3][CO1]	[10M]
6	Determining the winding inductances of a P-pole machine by considering a simplified 4-pole, 3-phase synchronous machine. Determine the self-inductance of the winding. the air-gap flux density due to current in the winding which can be expressed using an equation, $$B_r(\phi_s, \theta_{rm}) = \mu_0 \frac{\text{MMF}_{as}}{g(\phi_s - \theta_{rm})}$$	[L4][CO1]	[10M]
7	A permanent-magnet dc motor is rated at 6v with the following parameters: r_a=7 ohm, L_{AA}=120mH , K_V=1.41x10^{-2} V.s/rad, J= 1.06x10^{-6} Kg.m^2. According to the motor information sheet, the no-load speed is approximately and the no-load armature current is approximately. Calculate no load speed and damping	[L3][CO2]	[10M]

	coefficient associated with the mechanical rotational system of the machine N.m.s.		
8	Obtain the equivalent circuit of DC compound machine.	**[L2][CO2]**	**[10M]**
9	Derive the necessary equations and draw the Time-domain block diagram of a shunt connected dc machine.	**[L2][CO2]**	**[10M]**
10	Explain the dynamic performance of typical permanent-magnet and shunt dc motors with necessary diagrams.	**[L2][CO2]**	**[10M]**

UNIT –II

REFERENCE FRAME THEORY

1	What is the primary motivation for using a change of variables (referenc frame transformation) in the analysis of AC power system components an electric machines?	**[L3][CO3]**	**[10M]**
2	Given, f_{as}=cost, f_{bs}=(1/2)t and f_{cs}=-sint, then determine expressions for f_{qs}, f_{ds}, and f_{0s} using a reference frame theory and also draw the necessary phasor diagrams.	**[L3][CO3]**	**[10M]**
3	What is the physical significance or practical effect of applying $K_s L_s (K_s)^{-1}$ transformation to the inductance matrix?	**[L4][CO3]**	**[10M]**
4	Consider a 3-phase RL circuit defined by $\mathbf{r}_s = \text{diag}\,[r_s \quad r_s \quad r_s]$ $\mathbf{L}_s = \begin{bmatrix} L_s & M & M \\ M & L_s & M \\ M & M & L_s \end{bmatrix}$ transform above variables to the arbitrary reference frame and obtain Arbitrary reference-frame equivalent circuits for 3-phase RL circuit described by above equations.	**[L3][CO3]**	**[10M]**
5	Explain the commonly used reference with necessary variables and transformation employed.	**[L2][CO3]**	**[10M]**
6	Explain the concept, transformation between reference frames with necessary equations.	**[L2][CO3]**	**[10M]**
7	Explain the concept, balanced steady-state phasor relationships with necessary equations.	**[L2][CO3]**	**[10M]**
8	Consider a 3-phase RL circuit defined by $\mathbf{r}_s = \text{diag}\,[r_s \quad r_s \quad r_s]$ $\mathbf{L}_s = \begin{bmatrix} L_s & M & M \\ M & L_s & M \\ M & M & L_s \end{bmatrix}$ derive the phasor voltage equation for the above RL circuit for balanced steady-state conditions by using any three methods.	**[L4][CO3]**	**[10M]**
9	Explain the concept, balanced steady-state voltage equations with necessary equations.	**[L2][CO3]**	**[10M]**
10	Explain how the stationary circuit variables of resistive circuit and capacitive circuit are transformed to the arbitrary reference frame.	**[L3][CO3]**	**[10M]**

UNIT –III

MODELLING & DYNAMIC ANALYSIS OF THREE PHASE INDUCTION MACHINES

1	Derive voltage equations in machine variables for a 3-phase, wye-connected symmetrical induction machine.	[L2][CO4]	[10M]
2	Derive torque equation in machine variables for a 3-phase, wye-connected symmetrical induction machine.	[L3][CO4]	[10M]
3	Derive voltage equations in arbitrary reference-frame variables for a 3-phase, wye-connected symmetrical induction machine.	[L3][CO4]	[10M]
4	Derive torque equation in arbitrary reference-frame variables for a 3-phase, wye-connected symmetrical induction machine.	[L3][CO4]	[10M]
5	With necessary equations, analyze the steady-state operation of a symmetrical induction machine.	[L4][CO4]	[10M]
6	Obtain the arbitrary reference-frame equivalent circuits for a 3-phase, symmetrical induction machine.	[L2][CO4]	[10M]
7	The tests generally performed are a dc test, a no-load test, and a blocked-rotor test. the following test data are given for a 5-hp, 4-pole, 220-volt, 3-phase, 60-hz induction machine where all ac voltages and currents are rms values. dc test: $V_{dc} = 13.8$ V, $I_{dc} = 13.0$ A No-load test: $V_{nl} = 220$ V, $I_{nl} = 3.86$ A, $P_{nl} = 200$ W, $f = 60$ Hz Blocked-rotor test: $V_{br} = 23.5$ V, $I_{br} = 12.9$ A, $P_{br} = 469$ W, $f = 15$ Hz Determine the parameters of the Equivalent circuit for steady-state operation of a symmetrical induction machine.	[L3][CO4]	[10M]
8	Explain the free acceleration characteristics viewed from various reference frames of an induction motor in machine variables.	[L2][CO4]	[10M]
9	Explain the dynamic performance during sudden changes in load torque of a three-phase induction motor.	[L2][CO6]	[10M]
10	Explain the dynamic performance during a 3-phase fault at the machine terminals of a three-phase induction motor.	[L2][CO6]	[10M]

UNIT –IV

MODELLING& DYNAMIC ANALYSIS OF SYNCHRONOUS MACHINES

1	Derive voltage equations in machine variables for a 3-phase, wye-connecte salient pole synchronous machine.	[L2][CO5]	[10M]
2	Derive torque equation in machine variables for a 3-phase, wye-connected salient pole synchronous machine.	[L3][CO5]	[10M]
3	Derive voltage equations in arbitrary reference-frame variables for a 3-phase, wye-connected salient pole synchronous machine.	[L3][CO5]	[10M]
4	Draw the equivalent circuits of a 3-phase synchronous machine with the reference frame fixed in a rotor.	[L2][CO5]	[10M]
5	Derive the following torque equation for a 3-phase, wye-connected salient pole synchronous machine. $T_e = \left(\frac{3}{2}\right)\left(\frac{P}{2}\right)(\lambda_{ds} i_{qs} - \lambda_{qs} i_{ds})$	[L3][CO5]	[10M]
6	A 3-phase, 64-pole, hydro turbine generator is rated at 325 MVA, with 20-kV line-to-line voltage and a power factor of 0.85. The machine parameters in ohms at 60 Hz are: $r_s = 0.00234, X_q = 0.5911,$ and $X_d = 1.0467$. For a balanced, steady-state rated conditions calculate (a) E_a, (b) E'_{xfd}, and (c) T_e.	[L3][CO5]	[10M]
7	Explain the dynamic performance during sudden changes in input torque of a three-phase synchronous machine.	[L2][CO6]	[10M]

8	Explain the dynamic performance during a 3-phase fault at the machine terminals of a three-phase synchronous machine.	**[L2][CO6]**	**[10M]**
9	Compare the dynamic torque-angle characteristic during a step increase in input torque from zero to rated value with the calculated steady-state and approximate Torque angle Characteristics of a three-phase synchronous machine.	**[L2][CO5]**	**[10M]**
10	Using the approximate transient torque-angle curve along with the equal-area criterion, predict the large excursion dynamic behavior of a synchronous machine during a system fault.	**[L4][CO5]**	**[10M]**

UNIT –V
MODELLING OF SPECIAL MACHINES

1	Derive the voltage and torque equations in machine variables of a Permanent Magnet Brushless DC Motor.	**[L2][CO6]**	**[10M]**
2	Derive the voltage and torque equations in rotor reference-frame variables Permanent Magnet Brushless DC Motor.	**[L2][CO6]**	**[10M]**
3	Draw and explain the Torque-speed characteristics of a brushless dc motor with $L_q = L_d$ and $\phi_v=0$	**[L3][CO6]**	**[10M]**
4	Explain the Operating principle of a Permanent Magnet Brushless DC Motor.	**[L2][CO6]**	**[10M]**
5	Explain the Mathematical modelling of a Permanent Magnet Brushless DC Motor.	**[L2][CO6]**	**[10M]**
6	Explain the Speed-controlled Permanent Magnet Brushless DC Motor drive scheme without flux-weakening with the help of a block diagram.	**[L2][CO6]**	**[10M]**
7	Explain the Performance of a speed-controlled Permanent Magnet Brushless DC Motor drive system with PWM current controllers.	**[L2][CO6]**	**[10M]**
8	Explain the analysis of steady-state operation of Permanent Magnet Brushless DC Motor.	**[L2][CO6]**	**[10M]**
9	Explain the free acceleration characteristics of a Permanent Magnet brushless dc motor with $\phi_v = 0$.	**[L2][CO6]**	**[10M]**
10	Explain the free acceleration characteristics of a Permanent Magnet brushless with $\phi_v = 0$ and with inertia equal to five times rotor inertia.	**[L2][CO6]**	**[10M]**

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