## MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

P. Pages: 3

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Time : Three Hours ]
[ Max. Marks : 80
Note : (1) Separate answer book must be used for each section in the subject Geology, Engineering material of civil branch and Separate answer book must be used for Section A and B in Pharmacy and Cosmetic Tech.
(2) Answer Three questions from Section A and Three questions from Section B.
(3) Due credit will be given to neatness and adequate dimensions.
(4) Assume suitable data wherever necessary.
(5) Illustrate your answer wherever necessary with the help of neat sketches.
(6) Use pen of Blue/Black ink/refill only for writing the answer book.

## SECTION A

1. (a) Draw the basic 2-Pole machine diagrams.
(i) DC compound Machines.
(ii) Polyphase Induction Machine.
(iii) Synchronous Machine.
(b) With the help of suitable diagram describe the common essential features of rotating machines.

## OR

2. (a) Explain how a rotating commutator winding can be represented by a pseudo stationary coil on the moving element. Enumerate properties possessed by
this coil.
(b) Outline the various steps of applying the generalised theory to various
rotating electrical machine.
3. (a) What do you understand by the term 'Linear transformation' used in electrical Machine? Illustrate your answer with suitable example.
(b) Deduce Parks transformation relating the three phase current of synchronous machine to its corresponding $\mathrm{d}-\mathrm{q}$ axes currents. Express 3-phase currents in terms of d-q axes currents and its inverse.

## OR

4. (a) If the stator resistance of poly phase induction motor is neglected, Show that its torque can be expressed as -

$$
\mathrm{Tc}=\operatorname{Tem} \cdot \frac{2}{\frac{\operatorname{SmT}}{\mathrm{~S}}+\frac{\mathrm{S}}{\operatorname{SmT}}}
$$

(b) What is connection matrix ? Explain, with suitable example and its use for obtaining the transformed (or new) impedance and new voltage matrix. 6
5. (a) Draw the generalized mathematical model of a polyphase induction machine. Write down the voltage equation for this model and obtain there form equivalent circuit for polyphase induction motor.
(b) $\Lambda 10 \mathrm{KW}, 50 \mathrm{~Hz}, 6$ pole polyphase induction motor, has a full load ship of 0.04 if its friction and windage losses are $4 \%$ of output then compute.
(i) Rotor copper losses at full load.
(ii) Full load electromagnetic torque.
(iii) Rotor efficiency.

## OR

6. (a) Explain the term air-gap power Pg , internal Mechanical power developed Pm and shaft power Psh. How are these terms related with each other? 7
(b) Draw the equivalent circuit for a polyphase induction motor and state what is represented by the various parameters involved in this circuit.

## SECTION B

7. (a) What are the various basic parameters of a synchronous machine ? Derive the expression for armature to field mutual inductances and armature self inductances for a salient pole synchronous machine.
(b) Explain how Park's transformation transform equations in $a, b, c$, variables to $\mathrm{d}, \mathrm{a}, \mathrm{o}$, variables.

## OR

8. (a) Define the short circuit ratio of synchronous generator. Show that SCR is equal to reciprocal of per unit value of direct axis synchronous reactance Xd.
(b) X salient pole synchronous motor, connected with a infinite bus, is working at no load. Its field current is gradually reduced to zero and is then reversed.
(i) Find the magnitude of maximum creative excitation possible.
(ii) Find the magnitude.
9. (a) "At a time of synchronizing the frequency of incoming machine should be slightly higher than of the infinite bus" Justify this statement. 7
(b) Explain what you know about forced oscillation in synctrronous machinc.

## OR

10. (a) What are the causes of disturbance in synchronous machine ?
(b) Derive and show that the electro-mechanical equation for synchronous machine dynamics is given by
$P j \frac{D^{2} S}{d t^{2}}+K d \frac{d \delta}{d t}+P m \sin \delta=P_{\text {sh }}$
Here $\mathrm{Pj}, \mathrm{kd}$ and Psh are inertia power, electrical damping constant and shaft
power
respectively; pm is eaual to $\frac{\mathrm{Etvt}}{\mathrm{Xs}}$.
11. Explain the changes that must be made in linearized eauation of 3-phase induction
machine.

## OR

12. (a) Formulate the transfer function $(\Delta \omega r / \omega b) / \Delta T_{L}$ for synchronous machine.
