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Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

RE-Examination, June 2016

M.Tech. (Thermal), Sem-I **M.Tech. in Mechanical Engineering**

TRANSPORT PHENOMENA

Max. Marks: 100 **Duration:** 4 Hours

Master file.

Instructions:

- Answer any **FIVE** from seven questions.
- Answers to all sub questions should be grouped together
- Make suitable assumption if needed with proper reasoning
- Figures on right in square bracket shows maximum marks for a particular sub-question.

1. A. Write boundary layer equation under the assumption proposed by Prandtl. What is Von Karmon's Momentum Integral equation? Derive a mathematical expression for it. **[10]**

B. Assuming second degree velocity distribution in the boundary layer, determine using the integral momentum equation, the thickness of boundary layer, friction coefficient, displacement and momentum thicknesses. **[10]**

2. A. What is meant by exergy? Derive the expression for exergy loss in a process executed by: **[10]**
(a) closed system,
(b) open system.

B. Differentiate between developed and developing region for laminar and turbulent flow, **[10]**

For a given flow field $\vec{V} = \left(y^2 + 2xz\right)\vec{i} + \left(-2yz + x^2yz\right)\vec{j} + \left(\frac{1}{2}x^2z^2 + x^3y^4\right)\vec{k}$ explain

(i) Is this flow possible?
(ii) Is this flow steady or unsteady?
(iii)Is it a possible incompressible flow?
(iv) Find an expression for shear stress τ_{xy} and τ_{yz}.

3. A. Assume a steady incompressible laminar parallel flow between two parallel plates separated by a small gap 'b' and moving in opposite direction with equal velocity. Develop a governing equation for the problem using 2D-Navier Stokes equation and derive an expression for velocity profile. Estimate following quantities: **[10[**
Maximum and average velocity, (ii) Volume flow rate, and (iii) Pressure drop

B. Liquid water at 200 kPa and 20°C is heated in a chamber by mixing it with superheated steam at 200 kPa and 150°C. Liquid water enters the mixing chamber at a rate of 2.5 kg/s, and the chamber is estimated to lose heat to the surrounding air at 25°C at a rate of 1200 kJ/min. If the mixture leaves the mixing chamber at 200 kPa and 60°C, determine (*a*) the **[10[**

mass flow rate of the superheated steam and (b) the rate of entropy generation during this mixing process.

assuming minimum mesh size=12 cells and considering stability restriction imposed by explicit scheme, show time evolution of temperature for minimum 5 time steps in tabular form.

(Take thermal diffusivity α for the material as 10^{-5} m^2/s).

4. Answer any **four (04)** of the following with sufficient illustration: **[20]**
   (i) What is the need of thermodynamic laws for the analysis of thermal a system?
   (ii) What do you understand by boundary condition? Write about common thermal and flow boundary conditions.
   (iii) Discuss characteristic features of a turbulent flow.
   (iv) Define boundary layer. Explain the concept of displacement and momentum thickness.
   (v) What is flow separation? Why does it occur?

5. A. What is heat transfer coefficient? List down the important parameters influencing it. **[10]**
   Show the variation of h in laminar, transition and turbulent regions and explain the reasons for such variation.
   B. Write the differential form of common conservation law applied to a thermal system **[10]**
   and explain the meaning of each terms involved there.
   A liquid flows down an inclined plane surface in a steady, fully developed laminar film of thickness h. Simplify the continuity and Navier Stokes equations to model this flow field. Clearly state all the assumption made reasons.

6. A. Define and Explain the physical meaning of following non-dimensional numbers: **[10]**
   a. Reynolds number,
   b. Nusselt number,
   c. Prandtl number and
   d. Grashof number
   B. A pressure vessel has a volume of $2.83m^3$. It contains air at 7 MPa and 65°C. A valve is **[10]**
   now opened and highly pressurized air at a rate of 0.455 kg/s and at temperature 144.4°C enters the vessel. Determine the gas pressure and temperature in the vessel after 1 minute of charging.

7. A. What is transient heat conduction? Explain it with suitable examples. Listing all **[10]**
   assumption made in lumped parameter model analysis develop a governing equation and get a general solution. State the condition of its validity.

   B. Write differential form of energy equation and explain the different terms involved. **[10]**
   Simplify the equation for the following cases:
   a. Two dimension transient heat conduction
   b. One dimension transient heat conduction with heat generation.

   The temperature distribution across a copper plate 0.65 m thick heated from one side is given by $T = 70 - 80x + 24x^2$ where T is in K and x is in meters. Calculate the heat flux at x = 0, x = 0.25 m and x = 0.65 m. Thermal conductivity of the material is 386 W/mK.

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Re Examination
May 2016

Q. P. Code:
Duration: 4 Hours
Program: Electrical

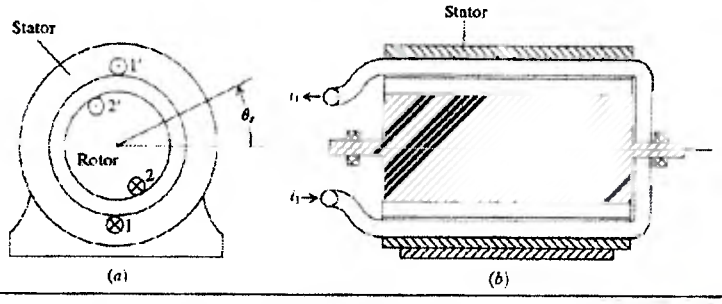
Max. Marks: 100
Class: M.Tech. Semester: I
Name of the Course: Modeling and Analysis of Electrical Machines
Course Code : MTPX 113

Master file.

Instructions:

1. **Question No. 1 is compulsory.**
2. Answer any four questions from remaining six.
3. Keep answers to the point.
4. Make suitable assumptions if required and justify the same.

Question No		Maximum Marks	Course Outcome Number
Q1a	Explain the phenomenon of Rotating MMF from the below given equation. $$MMF_s = \left(\frac{N_s}{2}\right)\sqrt{2}I_s\left(\frac{3}{2}\right)\cos[\omega_e t + \theta_{ei}(0) - \phi_s]$$	**06**	1
Q1b	Derive the arbitrary reference frame equivalent circuits for 3 phase RL circuit. Draw the equivalent circuit.	**10**	1,2
Q1c	Explain the advantages of dynamic models of electrical machines.	**04**	1,,2
Q2a	Explain the energy conversion principal graphically.	**10**	1

Q2b	Consider, $f_{as} = \cos t \qquad f_{bs} = \frac{1}{2}t \qquad f_{cs} = -\sin t$ Resolve f_{as}, f_{bs} *and* f_{cs} into f_{ds} *and* f_{qs} *for* $t = \frac{\pi}{3} s$ *and* $\theta = \frac{\pi}{4} rad$. and show these resolved quantities clearly into vector diagrams.	**10**	1,2
Q3a	Show that in synchronously rotating reference frame constant amplitude balanced set will appear as constants.	**10**	1,2
Q3b	Derive an expression for the electromagnetic torque of the elementary rotational device as shown in **figure below.** This device consists of two conductors. Conductor 1 is placed on the stationary member and conductor 2 is placed on rotor. 	**10**	1,2
Q4	For the arrangment shown in **Fig.1**, derive the expression for voltage equations expresed in terms of machine variables referred to the stator windings. Also derive the torque eauation for the same arrangement.	**14+06**	1,2
Q5	Derive the dynamic model of Induction Machine in arbitrary referrnece frame in terms of flux linkages as variables. Also draw the equivalent circuit.	**20**	1,2

Q6	For the arrangment shown in **Fig.2**, derive the expression for voltage equations expresed in terms of machine variables referred to the stator windings. Also derive the torque eauation for the same arrangement.	**14+06**	1,2
Q7a	Explain the steady state and dyanamic torque-speed characteristics of induction machines. Use appropriate figures for explanation	**10**	1,2
Q7b	Explain the need of sinusoidal distributed winding. Draw MMF distribution in space.	**10**	1,2

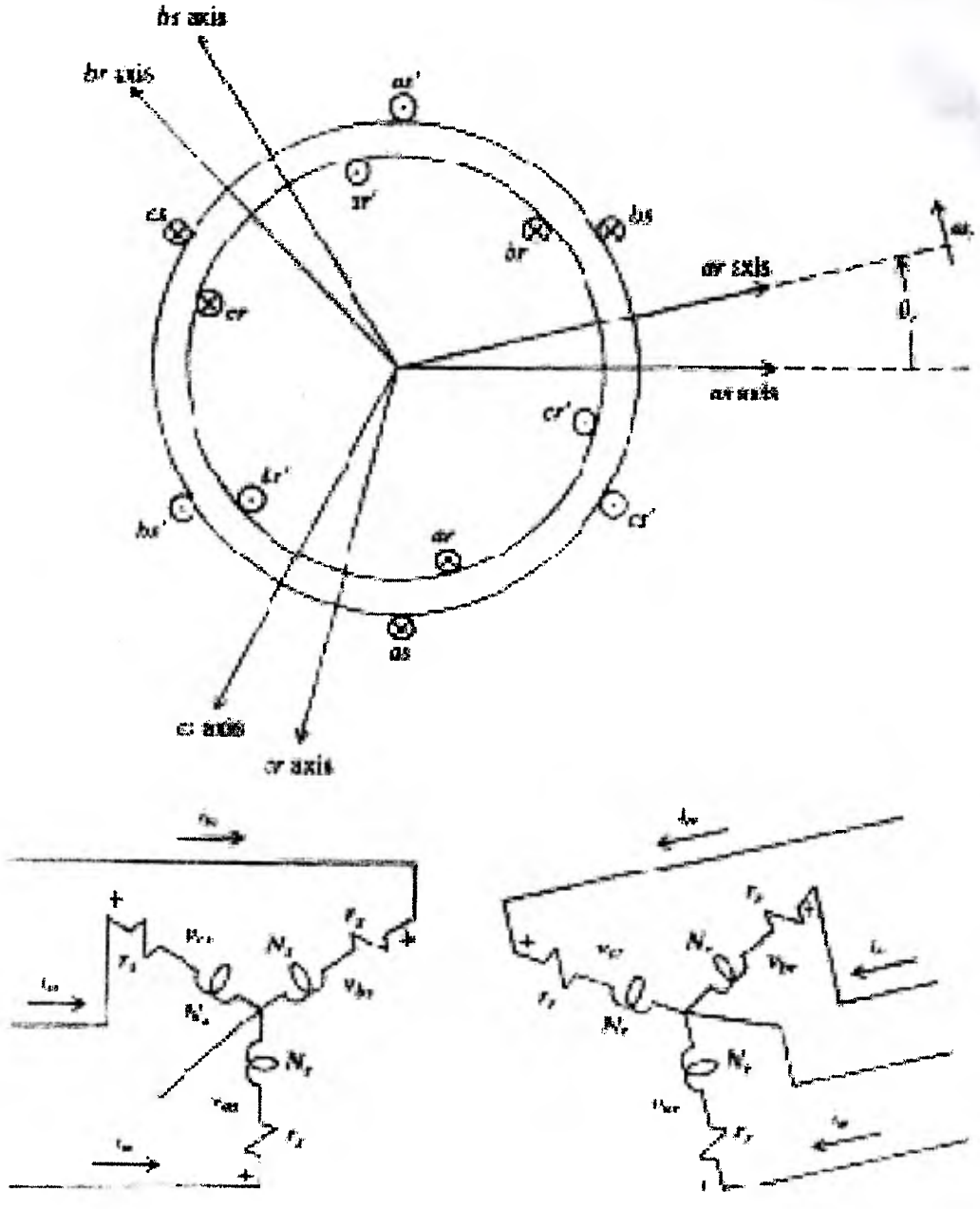

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Fig. 1

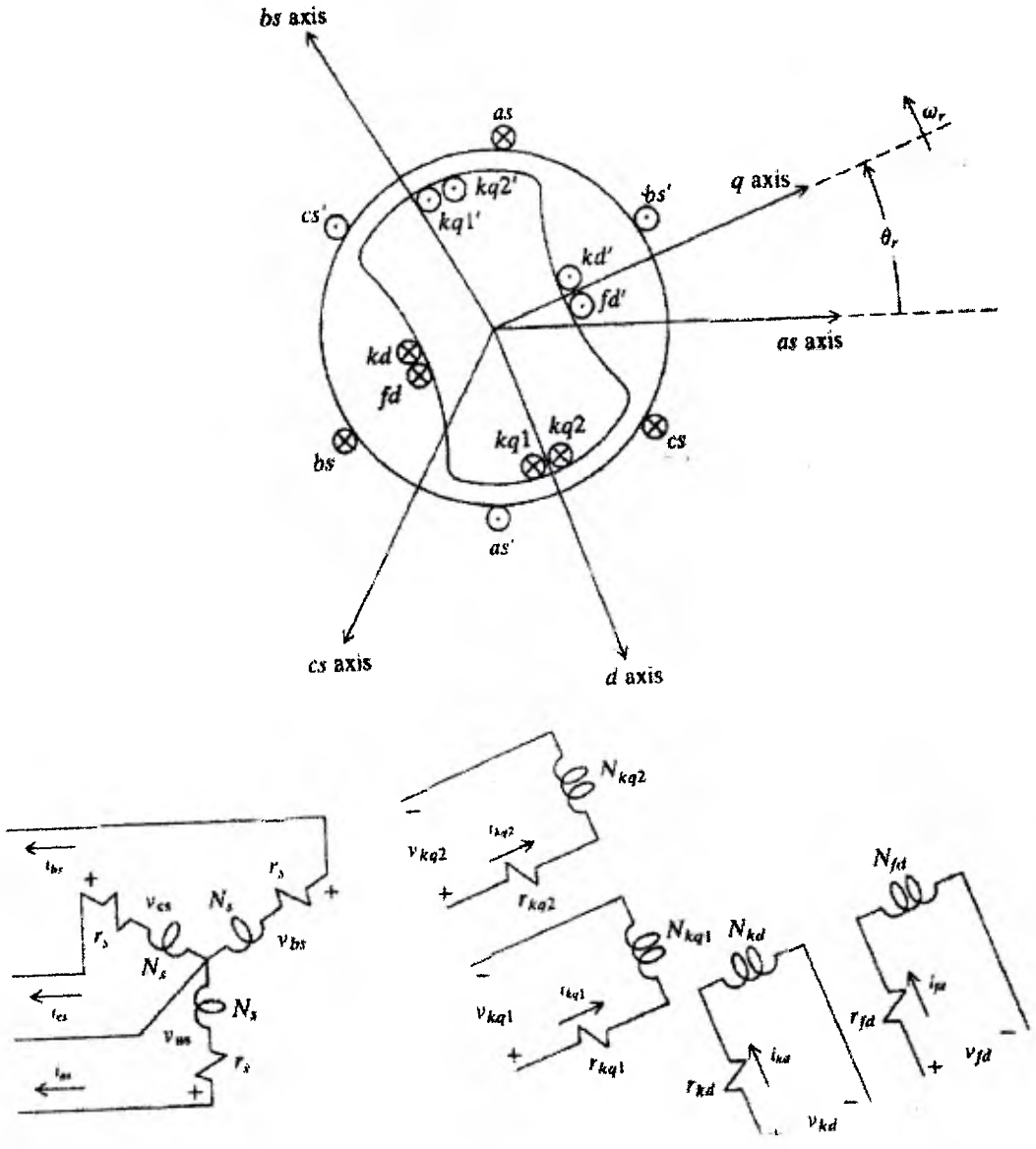
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Fig. 2