คำสั่ง **1.** ทำทุกข้อ(มี **5** ข้อ คะแนนรวม **100** คะแนน)

       2. <u>ไม่อนุญาต</u>   เอกสารคำสอนหรือตำรา

       3. <u>อนุญาต</u>   เครื่องคิดเลข,กระดาษ **A4** **1** แผ่น บันทึกข้อมูลใดๆด้วยลายมือเขียนได้ทั้ง **2** หน้า ,

                dictionary รวมถึง **electronic dictionary**

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1. A cast steel toroid of rectangular cross section has a mean circumference of 30 cm and a cross-sectional area of 4 cm^2. When the excitation current is 2A, the flux is found to be 0.48 mWb.

   Determine:

   1.1) the reluctance and the number of coil turns wound on this toroid,

                                                   (5 marks)

   1.2) the number of coil turns , if 1-mm air gap is cut across the cross section of this toroid,   (5 marks)

       (the magnetic flux and excitation current are unchanged)

   1.3) the reluctance of the air gap.   (5 marks)

B(Tesla)	0.9	1.0	1.2	1.3
H(At/m)	708	833	1250	1583

B-H of cast steel

2. A four-pole DC motor has 360 conductors on its armature, and 80% are directly under the pole face. The armature length is 18cm, its radius is 12cm,and the flux density under each pole is 0.9 T. The motor is rotating at 1500 rpm.

   For a Lap-wound armature winding, determine:

   2.1) the machine constant,   (5 marks)

   2.2) the counter EMF,   (5 marks)

   2.3) the electromagnetic torque developed when the conductor current is 30A,

                                                   (5 marks)

   2.4) the total force developed by the armature,   (5 marks)

   2.5) the power developed by the armature.   (5 marks)

3. A separately excited generator (with R_A=0.8 ohm) has a no-load voltage of
180 V when the field current is adjusted to 1.8A. The speed is 1,000 rpm.
Assume a linear relationship between the field flux and field current.
Determine:
3.1) the generated voltage when the field current is increased to 2.4A, and
the speed is increased to 1500 rpm,   (10 marks)
3.2) From the condition in 3.1). If the full-load current is 15A, what is the
voltage regulation?   (10 marks)

4. Calculate the required resistance for a two-step starter to limit the starting current
of a DC shunt motor to 150% of rated current . Assume all two steps have equal
resistance values. The motor is 20 hp, 230 V, 1500 rpm, and has an armature
resistance of 0.1 ohm and an efficiency of 90%. Determine the motor speed and
counter EMF at each step.   (20 marks)

5. A 220-V shunt motor has the following parameters:
   R_A= 0.5 ohm, R_F= 220 ohms, and rotational loss 300 W.
On full load the line current is 15A and the motor runs at 1200 rpm.
Determine:
   5.1) the developed power,   (5 marks)
   5.2) the output power,   (5 marks)
   5.3) the output torque, and   (5 marks)
   5.4) the efficiency at full load.   (5 marks)