

M.N.National Institute of Technology Allahabad

Allahabad 211004

Electrical Engineering Department

End semester Examinations for

B.Tech EE- VIth semester students' Academic year 2018-2019

Subject Name: Modern Electrical Machines (EE-1605)

Time: 0930 AM - 1230PM

Venue: FN-1(54) FN-3 (30)

Exam Date: 12-05-2018

Maximum Marks: 60

Faculty: Dr. M.Venkatesh Naik

- Answer all the questions
- Marks allotted for the question is mentioned at the end in brackets
- Mention question number before answering

1. a) Mention the typical applications of BLDC motor where high speed control accuracy and good dynamic response. (2)

b) What is the impact of change in supply voltage on mechanical power output of PMDC motor and derive a relation to get P_{max} . (3)

c) Give the trade-off points between speed and torque that effect efficiency of PMDC motor. (1)
2. a) Find the step angle of the following stepping motors: (a) 3- phase, VR, 12 stator teeth and 8 rotor teeth; (b) 3-phase, VR, three-stack, 16 rotor teeth; (c) 4-phase unipolar, hybrid, 50 rotor teeth. (3)

b) A motor with $K_T = 105 \text{ mNm/A}$, $R_{COIL} = 10 \Omega$ and ω_{NL} (at 48V) = 4,320 rpm will be operated with a 48 V supply. If this motor is connected to a 12:1 gearhead that has frictional torque losses of $T_{r,gearhead} = 2.4 \text{ mNm}$, what will the output shaft rotational speed be?
3. a) Give constructional details of VRSM type of motors. (3)

b) In which type of converter circuit the stored energy is fed back to the supply? Draw and explain the circuit used to excite the SRM windings. (3)
4. a) What are the low inertia type of PMDC motors? Give their constructional details and applications of each type. (3)

b) A PMDC motor has no load speed of 8000 rpm, when connected to 230 V supply. The armature resistance is 0.5 ohms. Find the speed when the supply voltage is 150V and torque is 1.5 Nm. Neglect the frictional and windage losses. (3)
5. Draw the block diagram of DSP based control scheme for BLDC motor and also give its flow chart of operation. (6)
6. a) A BLDC motor has a stall torque of 2.4 Nm with a current of 10 A. Find its no load speed when fed from a 50 V DC supply. During an overload, the magnetic loss is 12%. Find the speed if the load torque is 1.5 Nm. Assume a brush drop of 2V and neglect friction and windage losses. The armature resistance is 0.5Ω . (4)

b) In which type of control scheme the information of phase inductances are used to detect the rotor position in PMSM motors and draw the variation of phase inductance with rotor position. (2)

7. a) How can be the armature inductance is a function of rotor position in SynRM. (2)
b) Derive the relation for torque developed in SynRM. (2)
* ~~a)~~ Write the typical applications of SynRMs. (2)
8. a) What is condition to achieve maximum ^Wpower in PMDC motors and derive the relation corresponding to it. (3)
~~b)~~ Classify the BLDC motors based on several parameters. (3)
9. ~~a)~~ What are the various typical positioning applications of BLDC motors? (3)
b) For a 4 phase VRSM give the logic sequence for one phase ON, Two phase ON, 1-2-1-2 ON, three phase ON, 2-3-2-3 phase ON modes. (3)
- ~~10.~~ a) In which type of PMDC motor the iron core is replaced by glass fibre and what are the advantages of it. Also comment on the commutator and brushes used in such type of motors. (3)
~~b)~~ Draw the various configurations of BLDC motors. (3)