Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Electrical Actuators And Drives **Semester: II**
Program: M.Tech- Automation and Robotics Engineering **Time :03 hrs.**
Course Code: ECEG-7009 **Max. Marks: 100**
Instructions: All questions are compulsory in section A and B
Attempt any two in section C

SECTION A

		Marks	CO
Q 1	Write the DC motor performance equations, which are used in the mathematical model.	**4**	**CO2**
Q 2	Discuss the main factors influencing the selection of electric drives for robotic applications.	**4**	**CO1**
Q 3	Define the term solid-state relay and Reed-Relay-Coupled SSR with neat diagram.	**4**	**CO4**
Q 4	Explain the difference between poppet type and spool type valve.	**4**	**CO4**
Q 5	Briefly describe the principle of operation of three-phase induction motor.	**4**	**CO3**

SECTION B

Q 5	Now a days, in almost every application, hydraulic motors are used, and to control them hydraulic pumps and valves are employed. Depending on their application to the robotics actuation, explain with the help of neat diagram.	**10**	**CO4**
Q 6	Draw the torque-speed and slip characteristics of induction motor and briefly describe the various mode comes under the characteristics.	**10**	**CO3**
Q 7	A separately excited dc motor has the following parameters. $R=0.5\ \Omega$, $K_f=1$, $B=0.1$ kg m_2/sec , $J=2.0$ Kg m_2 The motor drives a constant load torque. With field current I_f =2 A and armature terminals connected to a 100 V dc source, the motor rotates at 450 rpm. (a) Determine the motor current la. (b) Determine the friction torque ($B\omega_m$) and the load torque (T_L).	**10**	**CO1,2**
Q 8	Describe the operation of closed loop torque and closed loop speed control scheme with inner current control loop.	**10**	**CO3**

SECTION-C

Q 9	(i) List down the various control strategies for speed control of Induction Motor and explain any two speed control method for slip ring induction motor. (ii) A 4 pole,1440 rpm,3 phase, induction motor is operated from a per phase	**10+10**	**CO3,4**

	voltage of 240 V/50 Hz and driving a constant load. Calculate the following at f=25 Hz and air gap flux is constant equals to 4.8: (a) Supply volt/phase (b) Slip (c) Slip frequency (d) Percentage rotor loss		
Q 10	A 400 V, star connected, 3 phase, 6 pole, 50 Hz induction motor has following parameters referred to the stator: Stator and rotor resistance=1 ohm, Stator and rotor reactance=2 ohm. For regenerative braking operation of this motor determine: (i) Maximum overhauling torque it can hold and range of speed for safe operation. (ii) Speed at which it will hold an overhauling load with a torque of 100 N-m. (iii) Maximum overhauling torque the motor can hold as a ratio of maximum overhauling torque without capacitor if a capacitive reactance of 2 ohm is inserted in each phase of stator.	**20**	**CO1,3**
Q 11	(i) A 220 V,dc series motor runs at 1000 rpm (clockwise) and takes an armature current of 100 A when driving a load with a constant torque. Resistances of the armature and field windings are 0.05 ohm each. Find the magnitude and direction of motor speed and armature current if the motor terminal voltage is reversed and the number of turns in field winding is reduced to 80%. Assume linear magnetic circuit. (ii) Explain the working principle of Rotary actuators and their types.	**10+10**	**CO2,4**

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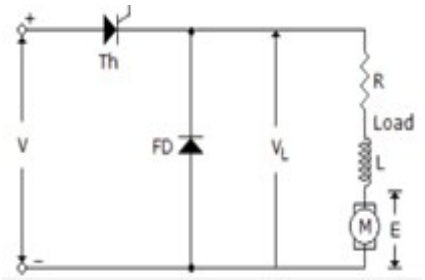
SECTION A

		Marks	CO
Q 1	List down the associated problems with the operation of induction motor with unbalanced rotor impedances.	4	CO3
Q 2	Define the term single phasing and how it can be avoided?	4	CO2
Q 3	Draw the various characteristics of dc shunt motor.	4	CO1
Q 4	Compare the operating modes of DC and induction motor with neat curve.	4	CO1,3
Q 5	Depending on fluid path, classify the Directional Control Valves.	4	CO4

SECTION B

Q 5	Discuss the possible solutions to improve the starting torque of 3 phase induction motor.	10	CO3
Q 6	A separately excited dc motor has the following parameters. $R=0.05\ \Omega$, $K_f=1$, $B=0.01$ kg m_2/sec , $J=2.0$ Kg m_2 The motor drives a constant load torque. With field current I_f =1 A and armature terminals connected to a 50 V dc source, the motor rotates at 450 rpm. (a) Determine the motor current la. (b) Determine the friction torque ($B\omega_m$) and the load torque (T_L).	10	CO1,2
Q 7	Analyze the DC to DC converter circuit shown in the fig below, driving a DC motor (RLE Load). Derive the expression for the peak-peak ripple current and find out the boundary condition for continuous current. 	10	CO2
Q 8	Describe the operation of stator voltage control and rotor voltage control in induction motor drives.	10	CO3

	SECTION-C		
Q 9	(i) Draw and explain the equivalent circuit of an induction motor. (ii) A 3 phase, 4 pole induction motoris operated from 415 V, 50 Hz supply. Stator voltage control is employed to vary the speed. The motoris driving a load torque of 100 Nm. Find out the following if the motor speed is 100 rad/sec: (a) Slip (b) Rotor components: air gap, slip power, mechanical output power. (c) Efficiency of the motor circuit.	**10+10**	**CO1,3**
Q 10	(i) With the help of natural characteristics, describe the plugging mode in induction motor drives. (ii) A 400 V, star connected, 3 phase, 6 pole, 50 Hz induction motor has following parameters referred to the stator: Stator and rotor resistance=1 ohm, Stator and rotor reactance=2 ohm is to be braked by plugging from its initial full load speed of 950 rpm. Stator to rotor turns ratio is 2.3 (a) Calculate the initial braking current and torque as a ratio of their full load values. (b) What resistance must be inserted in rotor circuit to reduce the maximum braking current to 1.5 times full load current? What will be initial braking torque now?	**10+10**	**CO2,3**
Q 11	(i) Practically for all the motors, the speed will drop as the load torque changes, this leads to the change in the motor torque and load torque characteristics does not guarantee a stable operating point, so in order to have stable equilibrium operating point derive the condition for system to be stable. (ii) Define the term actuators. Explain any application of robotics with the use of pneumatic actuators.	**10+10**	**CO1,4**