Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

**End Semester Examination – April/May– 2017**

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| **Sub.Code:** | **14EE3004** | **Duration :** | **3hrs** |
| **Sub. Name:** | **SOLID STATE DC DRIVES** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| Q. No. | Sub Div. | Questions | Course  Outcome | Marks |
| 1. | a. | Derive an expression for the back emf and developed torque of dc motor. | CO1 | 8 |
| b. | A 210V, 1200 rpm, 10 A separately excited motor is controlled by a single phase fully controlled converter with an ac source voltage of 230V,50Hz. Assume that sufficient inductance is present in the armature circuit to make the motor current continuous and ripple free for any torque greater than 25% of rated torque, Ra=1.5Ω   1. What should be the value of the firing angle to get the rated torque at 800rpm? 2. Compute the firing angle for the rated braking at -1200rpm. 3. Calculate the motor speed at the rated torque and α=1650 for the regenerative braking in the second quadrant? | CO1 | 12 |
| (OR) | | | | |
| 2. | a. | Deduce an expression relating speed and torque of a single phase full converter fed separately excited DC motor drive operating in the continuous current mode and discontinuous modes. | CO2 | 14 |
| b. | With relavant block diagram, explain the compoenets of basic electric drive system. | CO2 | 6 |
| 3. | a. | Explain the operation of a three phase fully controlled converter fed separately excited DC motor with neat waveforms and obtain the speed torque characteristics for continuous and discontinuous mode of operation. | CO2 | 10 |
|  | b. | A 220V, 1500rpm, 50A separately excited motor with armature resistance of 0.5 ohm is fed from a 3 phase fully controlled rectifier. Available ac source has a line voltage of 440V, 50Hz. A star-delta connected transformer is used to feed the armature so that the motor terminal voltage equals rated voltage when converter firing angle is zero. Determine the value of firing angle when   1. Motor is running at 1200 rpm and rated torque 2. When the motor is running at -800 rpm and twice the rated torque.   Assume continuous conduction. | CO1 | 10 |
| (OR) | | | | |
| 4. | a. | With relavant circuit diagrams and waveforms explain the operation of a single phase semi controlled converter fed dc series motor and obtain the speed torque characteristics for continuous and discontinuous mode of operation. | CO2 | 10 |
|  | b. | A separately excited dc motor is fed from 230V, 50Hz supply via single phase half controlled bridge rectifier. Armature parameters are: inductance 0.06H, resistance 0.3 ohm, the motor voltage constant 0.9V/A rad/sec and field resistance is 104 ohm. The field current is also controlled by a semi converter and is set to the maximum possible value. The load torque is TL=50 Nm at 800 rpm. The inductances of the armature and field circuits are sufficient enough to make the armature and field currents continuous and ripple free. Compute   1. The field current If 2. The firing angle of the converter in the armature circuit 3. The input power factor of the armature circuit converter. Neglect the losses. | CO1 | 10 |
| 5. | a. | With relevant circuit diagrams, explain the operation of regenerative braking control and dynamic braking control of dc separately excited motor with dc chopper. | CO2 | 10 |
|  | b. | A dc shunt motor takes a current of 80A on a 480V supply and runs at 960 rpm. The armature resistance is 0.25Ω and field resistance is 120Ω. A chopper is used to control the speed of the motor in the range of 400 to 700 rpm having constsnt torque. The on period of chopper is 3ms. The field is supplied directly from 480V. Determine the range of frequencies of the chopper. | CO1 | 10 |
| (OR) | | | | |
| 6. | a. | With relevant circuit diagram and waveforms explain the operation of first and second quadrant operation of chopper controlled dc separately excited motor in continuous and discontinuous current conduction mode. | CO2 | 10 |
|  | b. | A 230V, 960 rpm and 200A separately excited dc motor has an armature resistance of 0.02Ω. The motor is fed from a chopper which provides both motoring and braking operations. The source has a voltage of 230V. Assuming continuous conduction.   1. Calculate duty ratio of chopper for motoring operation at rated torque and 350 rpm. 2. Calculate duty ratio of chopper for braking operation at rated torque and 350 rpm. | CO1 | 10 |
| 7. | a. | Explain the functional block diagram of speed controlled four quadrant closed loop control of dc separately excited motor drive with controlled rectifier. | CO3 | 10 |
|  | b. | Derive an expression for the gain and time constant of the speed controller of the chopper fed dc drive with relevant block diagram. | CO3 | 10 |
| (OR) | | | | |
| 8. | a. | With relevant diagrams, explain the operation of two quadrant dc separately excited motor drive with field weakening. | CO3 | 10 |
|  | b. | Compare different current controllers used for the chopper controlled dc drive. Explain in detail with relevant circuit diagram and waveforms. | CO3 | 10 |
|  | | **Compulsory:** |  |  |
| 9. |  | Design a speed controlled dc motor drive maintaining the field flux constant. The motor parameters and ratings are as follows: 220V, 8.3A, 1470 rpm, Ra=4Ω, J=0.0607 kg-m2, La=0.072H, Bt=0.0869 Nm/rad/sec, kb=1.26V/rad/sec. The converter is supplied from 230V, 3 phase ac at 60Hz. The converter is linear and its maximum control input voltage is ±10V. The tacho-generator has the transfer function . The speed reference voltage has a maximum of 10V. The maximum current permitted in the motor is 20A. | CO3 | 20 |