**(3 Hours)** **Total Marks: 80**

**NB:** (1) Question **No. 1** is **compulsory**
(2) **Answer** any **THREE** questions out of the remaining **FIVE** questions.
(3) Assume suitable data if **necessary** and **justify** them
(4) **Figure** to the **right** indicates **marks**

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|---|---|---|---|
| 1 | (a) | Discuss the factors affecting the choice of an electrical drive with examples. | **5** |
| | (b) | Write the dynamic torque equation. Then, show how the time in a transient operation is calculated. | **5** |
| | (c) | Explain three phase fully controlled converter fed DC motor. | **5** |
| | (d) | Illustrate with block diagram anyone closed loop speed control of drives. | **5** |
| 2 | (a) | Explain the four quadrant operation of a motor with suitable example and discuss how a chopper fed motor can be used for this application. | **10** |
| | (b) | A drive has following parameters:<br>J=10 kg-m$^2$, $T$=100−0.1$N$, N-m, Passive load torque $T_l$ = 0.05$N$, N-m,<br>where N speed in rpm. Initially the drive is operating in steady state. Now it is to be reversed. For this motor characteristics is changed to $T$= −100−0.1$N$, N-m. Calculate the time of reversal. | **10** |
| 3 | (a) | Discuss the thermal model of electric machine. Illustrate how motor gets hot and cools down. Define heating and cooling time constants. | **10** |
| | (b) | Derive the expression for the overload factor for short time duty of a motor. | **10** |
| 4 | (a) | A 2.8 kW. 400 V, 50 Hz, 4 pole, 1370 rpm delta connected squirrel cage induction motor has following parameters referred to the stator: $R_s$ = 2Ω, $R_r'$ =5Ω, $X_s$=$X_r'$ =5Ω, $X_m$ =80 Ω. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate motor terminal voltage, current and torque at 1200 rpm. | **10** |
| | (b) | Why load equalization is required and derive the moment of inertia of the flywheel required for load equalization. | **10** |
| 5 | (a) | Describe the Plugging of three phase induction motor and show the transition of the operating point with relevant speed torque characteristics. | **10** |
| | (b) | A 3-phase 440 volt 50 hertz 6 pole star connected induction motor has following parameters referred to stator $R_s$ =0.05 Ω, $R_r$' =0.6, $X_s$ = $X_r$'= 1Ω. If the motor is used for the regenerative braking, determine-<br>(i) Maximum overhauling torque it can hold and range of speed in which it can operate.<br>(ii) The speed at which it will hold with a load of 160 N-m | **10** |
| 6 | (a) | Compare scalar control and vector control of AC drives. What do you mean by direct vector control? | **10** |
| | (b) | Show the implementation of DTC of 3-ph induction motor. | **10** |

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