Department of Electrical Engineering, I.I.T. Delhi
EEL332 Electrical Drives system
Minor test-1

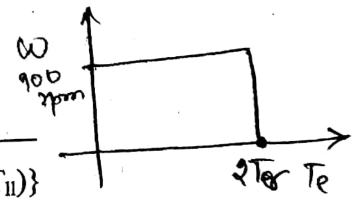
Venue: LH 114
Max Marks: 20
Date and Time: 5[th] Feb 2018; 11 to 12:00 hrs.

A. State TRUE or FALSE and justify your answer. Unless you state the reason, you will not get any marks just for stating TRUE or FALSE. (5 X 2 =10 Marks)

1. The variable losses in an electrical machine are copper losses only.
2. A crane which lifts up and brings down varying weights repeatedly, can use flywheel effectively, to reduce the rating of the electric motor to be employed.
3. Current transformers are very effective in sensing AC as well as DC currents. But they are very expensive.
4. If you compare the time constants involved in any drive system such as armature time constant (τ_a), field time constant (τ_f), thermal time constant (τ_h) and mechanical time constant (τ_m), they are related such that $\tau_f < \tau_a < \tau_h < \tau_m$.
5. The major limitation of a DC motor's overload capability is because of its commutator/brush arrangement.

B. A 2.18 kW, 2081 rpm,10 A, 230V Separately excited DC motor has an armature resistance of 1.2 Ω while drawing a rated field current of 1 A from a 230 V field supply. (a) To obtain a speed of 1000 rpm while delivering rated torque at rated I_f, what should be the applied armature voltage? At this condition, what would be the power delivered by the motor? (b) The motor is to be run at 3000 rpm by applying field weakening while delivering rated power at rated armature voltage. What should be the value of external field resistance to be included under this condition and what is the corresponding value of field current? (c) If armature reaction, under this operating condition, reduces the overall air gap flux to 85% of its original value (after field weakening), how much would be the corresponding increase in the speed? (6 MARKS)

C. A 100 kW 900 rpm electric motor has a speed torque curve such that from no-load to twice the rated torque, the speed-Torque curve is a straight line parallel to the torque axis and at twice the rated torque the characteristics is parallel to the speed axis. Minimum motor speed is to be restricted to 80% of its rated speed. The load driven by the motor has the torque variation as follows: 3000 Nm for 10 sec duration followed by 500 Nm for a duration long enough for the motor to attain steady speed. Calculate the Moment of Inertia (MI) of the flywheel if the motor torque should not exceed twice its rated torque. The MI of the motor is 10 kgm^2. (4 MARKS)



Expression for load equalization:

$$J = \frac{T_r}{(w_{m0}-w_{mr})}\,\frac{t_h}{\ln\{(T_{lh}-T_{min})/(T_{lh}-T_{max})\}} = \frac{T_r}{(w_{m0}-w_{mr})}\,\frac{t_l}{\ln\{(T_{max}-T_{ll})/(T_{min}-T_{ll})\}}$$

where T_r = rated torque; w_{m0}= no-load speed and w_{mr}=rated speed of the motor
T_{max} and T_{min} are maximum and minimum developed torque of the motor
T_{ll} and T_{lh} are the minimum and maximum load torques;
t_h and t_l are the duration for which maximum and minimum load toque persist.