SECTION A

S. No.		Marks	CO
Q 1	What are the main factors which decide the choice of electrical drives for a given application?	5	CO1
Q 2	Explain why a dc series motor is not started at no load condition.	5	CO2
Q 3	Why stator voltage control is suitable for speed control of induction motors in fan and pump drives?	5	CO3
Q 4	Deduce the basic difference between true synchronous mode and self control mode for variable frequency control of synchronous motor.	5	CO3

SECTION B

Q 5	Explain that the steady state stability of a drive depends on relative characteristic of the motor and load and not just on motor (or load) characteristics.	10	CO1
Q 6	A motor equipped with a flywheel is to supply a load torque of 1000 N-m for 10 seconds followed by a light load period of 200 N-m long enough for the flywheel to regains its steady state speed. It is desired to limit the motor torque to 700 N-m. Determine the moment of inertia of flywheel. Motor has an inertia of 10 Kg-m^2. Its no load speed is 500 rpm and the slip at a torque of 500 N-m is 5 %. Assume speed-torque characteristics of motor to be straight line in the region of interest.	10	CO1
Q 7	A 500 kw, 3 phase, 3.3KV, 50 Hz, 0.8 (lagging) power factor, 4 pole, star connected synchronous motor has following parameters: $X_s = 10\ \Omega$, $R_s = 0$. Rated field current is 8 A. Determine armature current and power factor at half the rated torque and rated field current. **OR** A Crane is used to carry weight in the industry. This Crane uses dc separately excited motor of 230 V, 100 A, 1000 rpm. This motor has an armature resistance of 0.04 Ω. The motor armature is fed from a variable voltage source with an internal resistance of 0.02 Ω. Determine internal voltage of the variable voltage source when the motor is operating in regenerative braking at 70% of the rated motor torque and 400 rpm.	10	CO2,CO3,CO4
Q 8	A 220 volt 24 ampere 100 RPM separately excited DC motor has an armature resistance of 2 Ω. Motor is controlled by a chopper with frequency of 500 Hz and source voltage of 230 V.	10	CO2,CO3,CO

	Determine the duty ratio for 1.2 times rated torque and 500 rpm.		**4**
	SECTION-C		

Q 9	Explain the following for variable frequency control of induction motor:
	     a- The motor has higher efficiency and better low speed performance when fed from a pulse width modulated inverter instead of 6 step inverter.
	     b- The motor has excellent low speed performance when fed from a Cycloconverter.
	     c- Cycloconverter control is suitable only for low speed drives
		20	**CO2,CO3,CO4**

Q 10	A 220 V, 1500 rpm, 10 A separately excited DC Motor is fed from a single phase fully controlled rectifier with an AC source voltage of 230 V, 50 Hz. $R_a = 2\ \Omega$. Conduction can be assumed to be continuous, determine
	
	     a- firing angle for half the rated motor torque and 500 RPM
	     b- firing angle for rated motor torque and (-1000) rpm.
	     c- motor speed for 160^0 firing angle at rated torque.
	
	  OR
	 A 2.8 KW, 400 V, 50 Hz, 4 pole, 1400 rpm, delta connected squirrel cage induction motor has following parameter referred to the stator: $R_s = 2\ \Omega$, $R_r^{'} = 2\ \Omega$, $X_s = X_r^{'} = 5\ \Omega$, $X_m = 80\ \Omega$. Motor speed is control by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Determine
	     a- motor terminal voltage, current and torque at 1200 rpm
	     b- motor speed, current and torque for the terminal voltage of 300 V.
		20	**CO2,CO3,CO4**

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: Electric Motor & Drives (EPEC 7008) **Semester: I**
Programme: M.Tech Rotating Equipment **Max. Marks: 100**
No. of pages: 2 **Time: 03 hrs.**
Instructions: All questions are compulsory.

SECTION A

S. No.		Marks	CO
Q 1	What are the reasons for using load equalization in an electrical drives?	**5**	**CO1**
Q 2	Explain why a dc series motor is more suited to deal with torque over loads than other dc motors.	**5**	**CO2**
Q 3	What are the advantages of squirrel cage induction motors over dc motors?	**5**	**CO2**
Q 4	In case of speed control of synchronous motor when operating in true synchronous mode, why the frequency must be changed in small steps?	**5**	**CO3**
	SECTION B		
Q 5	A weight of 1000 kg is being lifted up at a uniform speed of 2.5 m/s by a winch driven by a motor running at a speed of 900 rpm. The moment of inertia of the motor and the winch are 0.5 & 0.3 kg-m^2 respectively. Determine the motor torque and the equivalent moment of inertia referred to the motor shaft. In the absence of weight, motor develops a torque of 100 N-m when running at 1000 rpm.	**10**	**CO1**
Q 6	Explain what do you understand by load equalization. What are the reasons for using load equalization in an electrical drive?	**10**	**CO1**
Q 7	A 220 V, 1200 rpm, 15 A separately excited motor has armature resistance and inductance of 1.8 ohm and 32 mH respectively. This motor is controlled by a single phase fully controlled rectifier with an AC source voltage of 230 volt, 50 Hz. Identify the modes and calculate developed torque for a. $\alpha = 60^0$ and speed = 450 rpm b. $\alpha = 60^0$ and speed = 1500 rpm **OR** A 220 V, 1000 rpm, 50 A, dc separately excited motor has an armature resistance of 0.02 Ω. It is braked by plugging from an initial speed of 1000 rpm. Determine a- resistance to be placed in armature circuit to limit braking current to twice the full load value b- braking torque, c- torque when the speed fallen to zero.	**10**	**CO2,CO3,CO4**
Q 8	A 230 volt separately excited DC motor takes 50 ampere at a speed of 800 rpm. it has armature resistance of 0.4 Ω. This motor is controlled by a chopper with an input voltage of 230 V and frequency of 500 Hz. Assuming continuous conduction throughout calculate and	**10**	**CO2,CO3,CO4**

	plot speed torque characteristics for
	    a- Motoring operation at duty ratios of 0.3 and 0.6
	    b- Regenerative braking operation at duty ratios of 0.7 and 0.4		

	SECTION-C		
Q 9	An industrial fan type load is driven by a three phase squirrel cage induction motor. Show that rotor current is maximum when motor runs at a slip s=1/3. Find also an expression for maximum rotor current. Also determine the maximum current in terms of rated current for the motor running at (1) 1450 rpm (2) 1355 rpm. No load rotational losses are negligible	**20**	**CO2,CO3,CO4**

Q10	A 6 MW, 3-phase 11 KV, star connected, 6 pole, 50 Hz, 0.9 (leading) power factor synchronous motor has $X_s = 9\ \Omega$ and $R_s = 0$. Rated field current is 50 A. machine is controlled by variable frequency control at constant (V/f) ratio up to the base speed and at constant V above base speed. Determine
	    1- Torque and field current for the rated armature current, 750 rpm and 0.8 leading power factor
	    2- Armature current and power factor for half the rated torque, 1500 rpm and rated field current
	
	OR
	
	A centrifugal pump uses a 350 kw, 3 phase, 1.1 KV, 50 Hz, 0.9 (lagging) power factor, 4 pole, star connected synchronous motor. This motor has following parameters: $X_s = 20\ \Omega$, $R_s = 0$. Rated field current is 12 A. Determine
	
	    a- Armature current and power factor at half the rated torque and rated field current.
	    b- Field current to get unity power factor at the rated torque.
	    c- Torque for unity power factor operation at field current of 10 A.
		20	**CO2,CO3,CO4**