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

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

Course: Performance Analysis of Electrical Equipment **Semester: II**
Program: M. Tech. - ES **Time 03 hrs.**
Course Code: EPEC 8001 **Max. Marks: 100**

SECTION A

S. No.		Marks	CO
Q 1	The input power to a fan is 30kW for a 2500 Nm^3/hr fluid flow. The fan pulley diameter is 300mm. If the flow to be reduced by 15% by changing the fan pulley, what should be the diameter of fan pulley and power input to fan.	**4**	**CO1**
Q 2	What are the advantages of FRP blades over the conventional blades for cooling tower fans?	**4**	**CO2**
Q 3	Calculate the rotor I^2R losses using the following data: Slip = 4% Stator input = 3000 W Stator I^2R losses = 100 W Core loss = 50 W	**4**	**CO3**
Q 4	Explain the terms solar reflectance and fenestration.	**4**	**CO4**
Q 5	What is the significance of overall heat transfer coefficient (U-factor) in building energy consumption?	**4**	**CO4**

SECTION B

Q 6	Briefly explain with a sketch the concept of pump head flow characteristics and system resistance.	**10**	**CO2**
Q 7	A water pump is delivering 300 m^3/hr flow at 40 meter head at ambient conditions. The pump shaft power is 52kW. The impeller diameter is trimmed by 8%. Find out the new water flow, head and pump shaft power at the changed condition.	**10**	**CO2**
Q 8	During an energy audit, following data were obtained on a 3-phase induction motor:	**10**	**CO3**

	Rated values: 37 kW, 415V, 66 A, 0.88 pf Operating values: 410 V, 49A, 0.76 pf Note: Motor efficiency in this particular case does not change between 50 –100 % loading. The plant operates for 7000 hours per year with the electricity cost of Rs. 6.00 per unit. It is proposed to replace the existing motor by a 30 kW energy efficient motor with 92% efficiency. a) Determine the rated efficiency and the loading of the existing motor. b) Calculate the loading with energy efficient motor. c) If replacing the existing motor with energy efficient motor which costs Rs.75,000. Determine the payback period for the investment required for the energy efficient motor over the existing motor. Consider the salvage value of the existing motor as Rs.10,000/.		
Q 9	Explain in detail the "Building Management System (BMS)" with the help of block diagram.	**10**	**CO4**
	SECTION-C		
Q 10	A free air delivery test was carried out before conducting a leakage test on a reciprocating air compressor in an engineering industry and following were the observations: Receiver capacity : 10 m^3 Initial pressure : 0.2 kg / cm^2g Final pressure : 7.0 kg / cm^2g Additional hold-up volume : 0.2 m^3 Atmospheric pressure : 1.026 kg / cm^2 abs. Compressor pump-up time : 4.5 minutes The following was observed during the conduct of leakage test during the lunch time when no pneumatic equipment/ control valves were in operation: a) Compressor on load time is 30 seconds and unloading pressure is 7 kg/cm^2g b) Average power drawn by the compressor during loading is 90 kW c) compressor unload time and loading pressure are 70 seconds and 6.6 kg/cm^2 g respectively. Find out the following: (i) Compressor output in m^3/hr (neglect temperature correction) (ii) Specific Power Consumption, kW/ m^3/hr (iii) % air leakage in the system (iv) leakage quantity in m^3/hr (v) power lost due to leakage	**20**	**CO1**
SQ 11	Explain in detail - A typical modern age intelligent VFD for the 3 phase induction motor.	**20**	**CO3**

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SECTION A

S. No.		Marks	CO
Q 1	An energy audit of a fan was carried out. It was observed that the fan was delivering 18,500 Nm^3/hr of air with static pressure rise of 52 mm WC. The power measurement of the 3-phase induction motor coupled with the fan recorded 3.1 kW/ phase on an average. The motor operating efficiency was assessed as 88% from the motor performance curves. What would be the fan static efficiency?.	**4**	**CO1**
Q 2	Estimate the cooling tower capacity (TR) with the following parameters Water flow rate through CT = 120 m^3/h SP. Heat of water = 1 k.Cal/kg °C Inlet water temperature = 37 °C Outlet water temperature = 32 °C Ambient WBT = 29 °C	**4**	**CO2**
Q 3	A 75 kW, 415 V, 140 Amp, 4 pole, 50 Hz, 3-phase squirrel cage induction motor has a full load efficiency of 87.6%. The measured operating motor terminal voltages in a 3-phase supply are 415 V, 418 V & 420 V. The current drawn in 3-phase supply are 137 Amp, 132 Amp & 137 Amp. Estimate the additional temperature rise of motor, due to unbalanced voltage supply.	**4**	**CO3**
Q 4	Explain the terms visible light transmittance and effective aperture of glazing.	**4**	**CO4**
Q 5	Explain briefly the meaning of solar heat gain coefficient.	**4**	**CO4**

SECTION B

Q 6	List down few energy conservation opportunities in pumping system.	**10**	**CO2**
Q 7	A pump is filling water in to a rectangular overhead tank of 5 m x 4 m with a height of 8 m. The inlet pipe to the tank is located at height of 20 m above ground. The	**10**	**CO2**

	following additional data is collected : • Pump suction : 3 m below pump level • Overhead tank overflow line : 7.5 m from the bottom of the tank • Power drawn by motor : 5.5 kW • Motor efficiency η : 92% • Time taken by the pump to fill the overhead tank upto overflow level : 180 minutes Assess the pump efficiency.		
Q 8	A 415 V, 15kW, 3-ph, 50Hz Induction motor operates at full load, with 88% efficiency and 0.85 power factor lagging: a) Find the current drawn by the motor b) If this motor is replaced by 92.5% energy efficient motor with 0.92 power factor, what will be the power savings in terms of k W and kVA?	**10**	**CO3**
Q 9	List ten energy consumption measures in buildings.	**10**	**CO4**
	SECTION-C		
Q 10	In an automobile industry one compressor of rated capacity of 1000cfm is operated to evaluate leakage quantity in the plant during a holiday when no equipment was using compressed air. FAD test was also carried out before conducting leakage test and found that the compressor is delivering output of 90% of rated capacity. The observation on leakage test are: a) Compressor was on full load for 8 min b) Compressor was unloaded for 48 min c) Compressor was consuming 144 kW Evaluate : a) Free air delivery b) specific power consumption c) % leakage in compressed air system d) Leakage quantity e) power lost due to leakage	**20**	**CO1**
Q 11	Explain the function of Soft Starters in case of Induction Motor. Also explain its starting current and stress profile during starting with the help of diagrams.	**20**	**CO3**