



**COLLEGE:** COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)  
**SCHOOL:** ELECTRICAL & ELECTRONICS ENGINEERING  
**PROGRAMME:** TRADE DIPLOMA IN RENEWABLE ENERGY ENGINEERING  
**UNIT CODE:** REE 590  
**TITLE:** ENERGY CONSERVATION TECHNOLOGY

## FINAL EXAMINATION – TRIMESTER 2, 2017

TIME: 3 HOURS 10 MINUTES

DAY/DATE: TBC/ TBC TIME: TBC ROOM: TBC

### INSTRUCTIONS TO STUDENTS

1. You are allowed 10 minutes Extra reading time during which you are NOT to write.
2. Begin each section on a fresh page and use both sides of the sheet.
3. Write your candidate-number at the top of each attached sheet.
4. Insert all written foolscaps, graph paper, drawing paper, etc. in their correct sequence and secure with string.
5. For all sheets of paper on which rough or draft work has been done, cross it through and you MUST ATTACH to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. Answers to all questions must be written in INK on the Answer sheet provided and show all working where necessary.
8. Only Non-programmable calculators are allowed.
9. ATTEMPT all questions.

## SECTION A – Theoretical Based, - 50 MARKS

1. Differentiate between energy conservation and energy efficiency. Why energy conservation is important in the prevailing energy scenario?  
( 5 marks)
2. a) What is the impact of condensing temperature and evaporator temperature on the Coefficient of Performance (COP) of a refrigeration system? (2 marks)  
  
b) In a throttle valve-controlled pumping system with oversized pump, name any three solutions for improving energy efficiency. ( 3 marks)
3. Discuss in brief any three methods by which energy can be saved in an air conditioning system. ( 5 marks)
4. Briefly explain with a diagram and calculate the energy loss due to throttling in a centrifugal pump. ( 10 marks)
5. List down **five** energy conservation opportunities in pumping system. ( 5 Marks )
6. State any **five** best practices in a lighting system for energy savings? ( 5 Marks )
7. List **five** energy savings measures for an industrial DG set plant. (5 Marks)
8. Define the terms
  - (i) Colour Rendering Index (RI)
  - (ii) Illuminance
  - (ii) lux (lx)
  - (iii) Luminous Efficacy (lm/W)
  - (iv) Control Gear ( 5 marks )
9. List **five** advantages of power factor improvement? ( 5 marks )

## SECTION B – Numerical Based - 50 MARKS

1. (i) A 10 kVAr, 415 V rated power factor capacitor was found to be having terminal supply voltage of 440 V. Calculate the capacity of the power factor capacitor at the operating supply voltage. ( 2 marks)
- (ii) The utility bill shows an average power factor of 0.72 with an average KW of 627. How much kVAr is required to improve the power factor to 0.95? ( 3 marks)

2. Shown below is a motor specification and the no-load test data.

Motor Specifications	
Rated power	34kW/45 HP
Voltage	415Volts
Current	57 Amps
Speed	1475 rpm
Insulation Class	F
Frame	LD200L
Connection	Delta
No load test Data	
Voltage	415 Volts
Current	16.1 Amps
Frequency	50 Hz
Stator phase resistance at 30 deg celcius	0.264 ohms
Power at no load	1063.74 watts

Solve these following questions

- a) Calculate iron plus friction and windage losses
- b) Calculate stator resistance at 120 °C
- c) Calculate stator copper losses at operating temperature of resistance at 120 °C
- d) Calculate full load slip(s) and rotor input assuming rotor losses are slip times rotor input.
- e) Determine the motor input assuming that stray losses are 0.5 % of the motor rated power
- f) Calculate motor full load efficiency and full load power factor (10marks)

3. A no load test conducted on a three phase delta connected induction motor gave the following values: ( 5 marks )

No load power = 890 W  
Stator resistance per phase at 30°C = 0.233 Ohms  
No load current = 14.5 A

Calculate the fixed losses for the motor.

4. The power input to a three phase induction motor is 45 kW. If the induction motor is operating at a slip of 2% and with total stator losses of 1.80 kW, determine the total mechanical power developed. (5 marks)

5. A pump is delivering 40 m<sup>3</sup>/hr of water with a discharge pressure of 29 metre. The water is drawn from a sump where water level is 6 metre below the pump centerline. The power drawn by the motor is 7.5 kW at 89% motor efficiency. Find out the pump efficiency. (5 marks)

6. In the leakage test in a process industry, following results were observed

Compressor capacity (m <sup>3</sup> /minute)	=	35
Cut in pressure, kg/cm <sup>2</sup>	=	6.8
Cut out pressure, kg/cm <sup>2</sup>	=	7.5
Load kW drawn	=	188 kW
Unload kW drawn	=	54 kW
Average 'Load' time	=	1.5 minutes
Average 'Unload' time	=	10.5 minutes

Calculate leakage quantity and avoidable loss of power due to air leakages.

( 5 marks)

7. What is the net refrigeration load in TR when 15 m<sup>3</sup>/hr of water is cooled from 21°C to 15°C? If the compressor motor draws 29 kW, chilled water pump draws 4.6 kW, condenser water pump draws 6.1 kW and Cooling Tower fan draws 2.7 kW, what is overall kW/TR?

( 5 marks)

8. A new small cogeneration plant installation is expected to reduce a company's annual energy bill by \$486,000. If the capital cost of the new boiler installation is \$2,220,000 and the annual maintenance and operating costs are \$ 42,000, what is the expected payback period for the project?  
( 5 marks)

9. An instrument air compressor capacity test gave the following results (assume the final compressed air temperature is same as the ambient temperature) – Calculate and comment on compressor output capacity.

Piston displacement	: 16.88 m <sup>3</sup> /minute	
Theoretical compressor capacity	: 14.75 m <sup>3</sup> /minute @ 7 kg/cm <sup>2</sup>	
Compressor rated rpm 750	: Motor rated rpm : 1445	
Receiver Volume	: 7.79 m <sup>3</sup>	
Additional hold up volume, i.e., pipe / water cooler, etc., is	: 0.4974 m <sup>3</sup>	
Total volume	: 8.322 m <sup>3</sup>	
Initial pressure P1	: 0.5 kg/cm <sup>2</sup>	
Final pressure P2	: 7.03 kg/cm <sup>2</sup>	
Atmospheric pressure P0	: 1.026 kgf/cm <sup>2</sup> A	
Compressor Pumpup time	: 4.021 minutes	( 5 marks )

\*\*\*\*\*THE END\*\*\*\*\*