

Sustainable and Renewable Energy Development Authority (SREDA)

Power Division, Ministry of Power, Energy and Mineral Resources

2nd Energy Auditor Certification Examination-2022

Paper- 3

Candidate's Roll No.

2 0 2 2 0 3

Examinee's Name _____

Invigilator's Signature

B

Paper 3: Energy Efficiency in Electrical Systems
Total Marks- 150, Time- 3.00 Hours, Date: 6 March 2022

• Important Instruction:

1. This Paper has 50 MCQs + 8 Short Questions + 6 Long Questions = Total 64 Questions.
2. Mark indicated on the right side of each question.
3. Fill in correct circle with permanent ink ballpoint pen shown on the top sheet only corresponding to the MCQ given in Section A.
4. Answer in the blank space provided after each question (short/long).
5. Do not put any sign or write anything on the answer script except written answer.
6. Any unfair means, peer talking, keeping any communication device and misbehavior will lead to cancellation of examination.

MCQ Answer (Section A):

1		18		35	
2		19		36	
3		20		37	
4		21		38	
5		22		39	
6		23		40	
7		24		41	
8		25		42	
9		26		43	
10		27		44	
11		28		45	
12		29		46	
13		30		47	
14		31		48	
15		32		49	
16		33		50	
17		34			

Invigilator's Signature

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MCQ	:	[]	
Short Question	:	[]	
Long Question	:	[]	
Total Marks	:	[]	Signature of Examiner

Do not write or mark anything in this page

Section A

Fill the appropriate circle in the OMR answer sheet at the top page.

1 x 50 =50

- 1 The power factor of an alternator depends on
 - A) load
 - B) speed of rotor
 - C) core losses
 - D) armature losses.
- 2 The cascade efficiency in the T&D system from output of the power plant to the end use is
 - A) greater than 90%
 - B) between 80 to 90%
 - C) 70 to 80%
 - D) less than 70%
- 3 In order that two transformers be put in parallel, which of the following factors should be identical for both?
 - A) Same percentage impedance.
 - B) Same polarity.
 - C) Same Phase sequence
 - D) all of the above
- 4 For the same power rating, a lower voltage alternator will be
 - A) more efficient
 - B) larger in size
 - C) operating at high rpm
 - D) smaller in size
- 5 Skin effect depends on
 - A) size of the conductor
 - B) frequency of the current
 - C) resistivity of the conductor material
 - D) all of the above
- 6 For better energy efficiency, the capacitors for power factor correction should be placed near
 - A) the LT panel
 - B) high inductive loads
 - C) service drop
 - D) none of the above
- 7 Which one of the following is not the effects of harmonics on distribution network?
 - A) Misfiring of AC and DC Drives
 - B) Reduced power factor
 - C) Overloading and overheating of motors
 - D) none of the above
- 8 Which one of the following motor mostly used in the industry?
 - A) Synchronous Motor
 - B) Wound Rotor Induction motor
 - C) Squirrel-cage Induction Motor
 - D) DC Shunt Motor
- 9 In short circuit test of a transformer the wattmeter reading roughly gives
 - A) core loss
 - B) copper loss
 - C) both (A) and (B)
 - D) none of the above

- 30 Typical range of COP value for a compression refrigeration cycle is
 A) 1 to 5 C) 2 to 5
 B) 1 to 10 D) 2 to 20
- 31 The choice of fan type for a given application depends on
 A) flow C) neither (A) nor (B)
 B) static pressure D) both (A) and (B)
- 32 Axial fans are best suitable for applications with
 A) large flow, low head C) low flow, low head
 B) large flow, high head D) large flow, high head
- 33 The most efficient method of flow control in a pumping system is
 A) throttling the flow C) impeller trimming
 B) speed control D) none of the above
- 34 Small by-pass lines are installed some times to
 A) control flow rate C) prevent pump running at zero flow
 B) control pump delivery head D) reduce pump power consumption
- 35 Friction losses in a pumping system is
 A) proportional to $1/Q$ C) proportional to $1/Q^3$
 B) proportional to Q^2 D) none of the above
- 36 The maximum permissible percentage unbalance in phase loads on DG sets is
 A) 15% C) 5%
 B) 10% D) 1%
- 37 The operating efficiency of DG set also depends on
 A) turbo charger C) loading
 B) inlet air temperature D) all of the above
- 38 Energy savings potential of variable torque applications compared to constant torque application is
 A) lower C) equal
 B) higher D) all of the above
- 39 Application of timers as a retrofit will assist in saving energy in areas of
 A) Lighting & motors C) HV- Feeder Panels
 B) Transformers D) all of the above
- 40 Energy Efficient transformer core is made up of
 A) silicon alloyed iron (grain oriented) C) amorphous core - metallic glass alloy
 B) copper D) none of the above
- 41 For the same quantity of power handled
 A) lower the voltage, higher the current C) higher the voltage, higher the current
 B) lower the voltage, lower the current D) none of the above

- 42 Ice bank system is used in milk & dairy industry. Ice is made in lean period and used in peak load period. Thus maximum demand is
- A) increased
B) moderate
C) reduced
D) none of the above
- 43 Devices that draw non-sinusoidal current when a sinusoidal voltage is applied create
- A) harmonics
B) light
C) melody
D) none of the above
- 44 Customer is responsible for maintaining current distortion within acceptable levels, while utility is responsible for limiting
- A) power distortion
B) voltage distortion
C) VAR distortion
D) VA distortion
- 45 In star connected electric system
- A) $V_{\text{line}} = \sqrt{2} V_{\text{phase}}$
B) $V_{\text{line}} = V_{\text{phase}}$
C) $V_{\text{line}} = \sqrt{3} V_{\text{phase}}$
D) $V_{\text{line}} = 3 V_{\text{phase}}$
- 46 In electric systems, induction motors, especially those operating below their rated capacity, are the main reason for
- A) high power factor
B) low power factor
C) unity power factor
D) none of the above
- 47 Squirrel cage motors compare to slip-ring motors are generally
- A) less efficient
B) almost equally efficient
C) more efficient
D) none of the above
- 48 Lower – speed motors compare to higher – speed motors are normally
- A) less efficient
B) almost equally efficient
C) more efficient
D) none of the above
- 49 Friction and windage losses of motors result from
- A) bearing friction
B) windage friction
C) circulating air friction
D) bearing friction, windage and circulatory air through the motor
- 50 The power loss in line is proportional to
- A) resistance and current
B) square of resistance and current
C) square of current multiplied by resistance
D) all of the above

Section B: Short Question

		Marks
01	What is “CRI” in lighting technology?	5
02	What is Total Harmonic Distortion (THD)? List any five problems that can arise due to harmonics in a system.	5

03	Comment on 'construction aspects' how an "energy efficient motor" is different from a "standard motor".	5
04	How do you define percentage unbalance in voltage? Write five common causes of voltage unbalance.	5

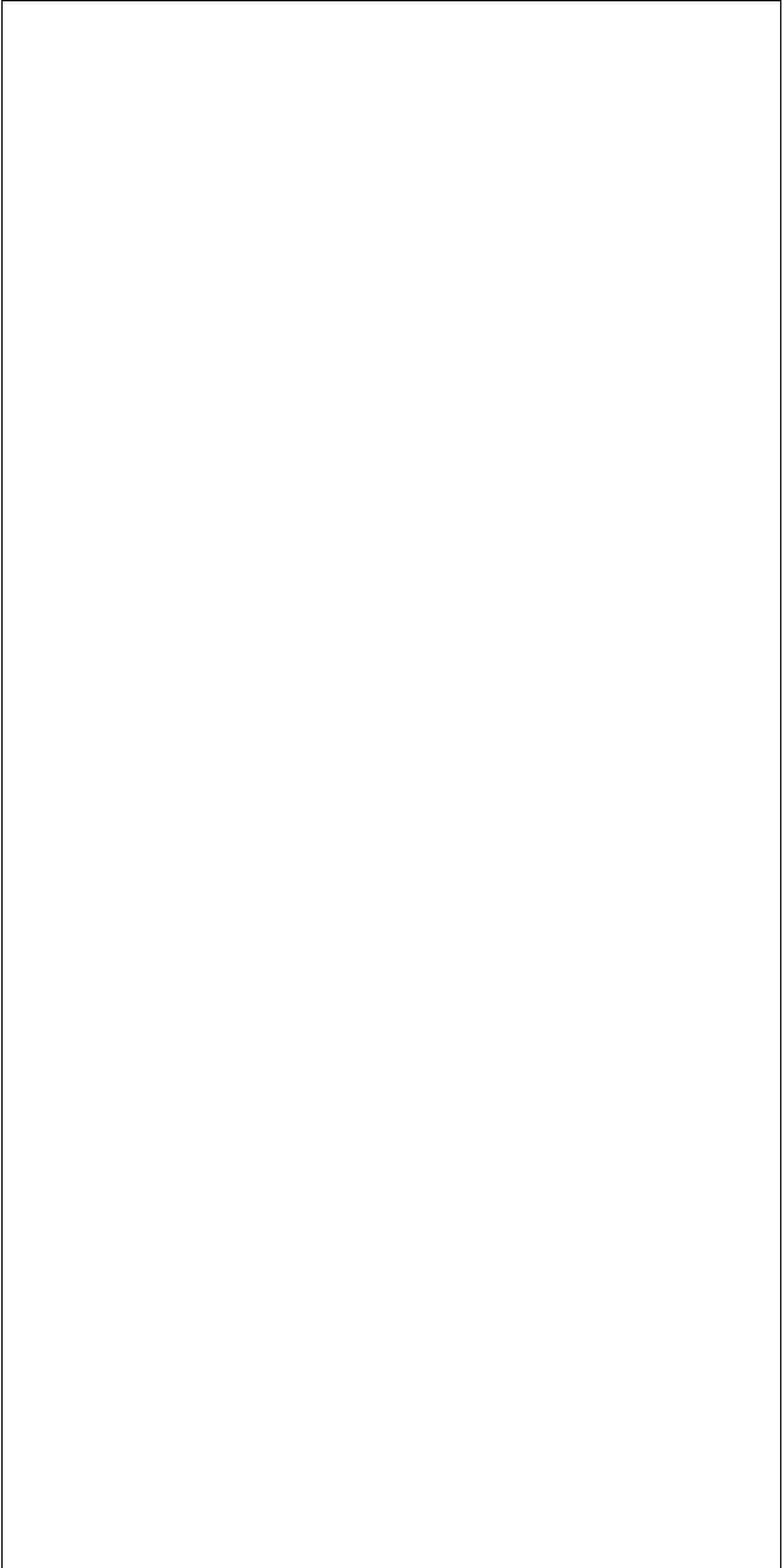
05	Calculate the annual energy savings and simple payback from replacing an existing 20 HP standard motor (efficiency 88.3%) with a premium efficiency motor (efficiency 93.5%) when the annual operating hour is 5000, Load Factor 0.75 and Energy tariff is 8.57 Tk./kWh. The cost of the old motor and the premium motor are 40,000 and 80,000 Tk, respectively.	5
06	Ice is formed at 0°C from water at 30 °C. In the refrigeration system, same temperature water is used for condenser cooling and the temperature of the brine is -15°C at evaporator. Consider the system as ideal refrigeration; find the COP of the refrigeration system?	5

07	List at least five energy saving opportunities for a fan application.	5
08	<p>Airflow measurements using the pitot tube, in the primary air fan of a coal fired boiler gave the following data, calculate the velocity of air in m/sec.</p> <p>Air temperature = 38°C Velocity pressure = 47 mm Water Column Pitot tube constant, $C_p = 0.9$ Air density at 38°C = 1.135 kg /m³</p>	5

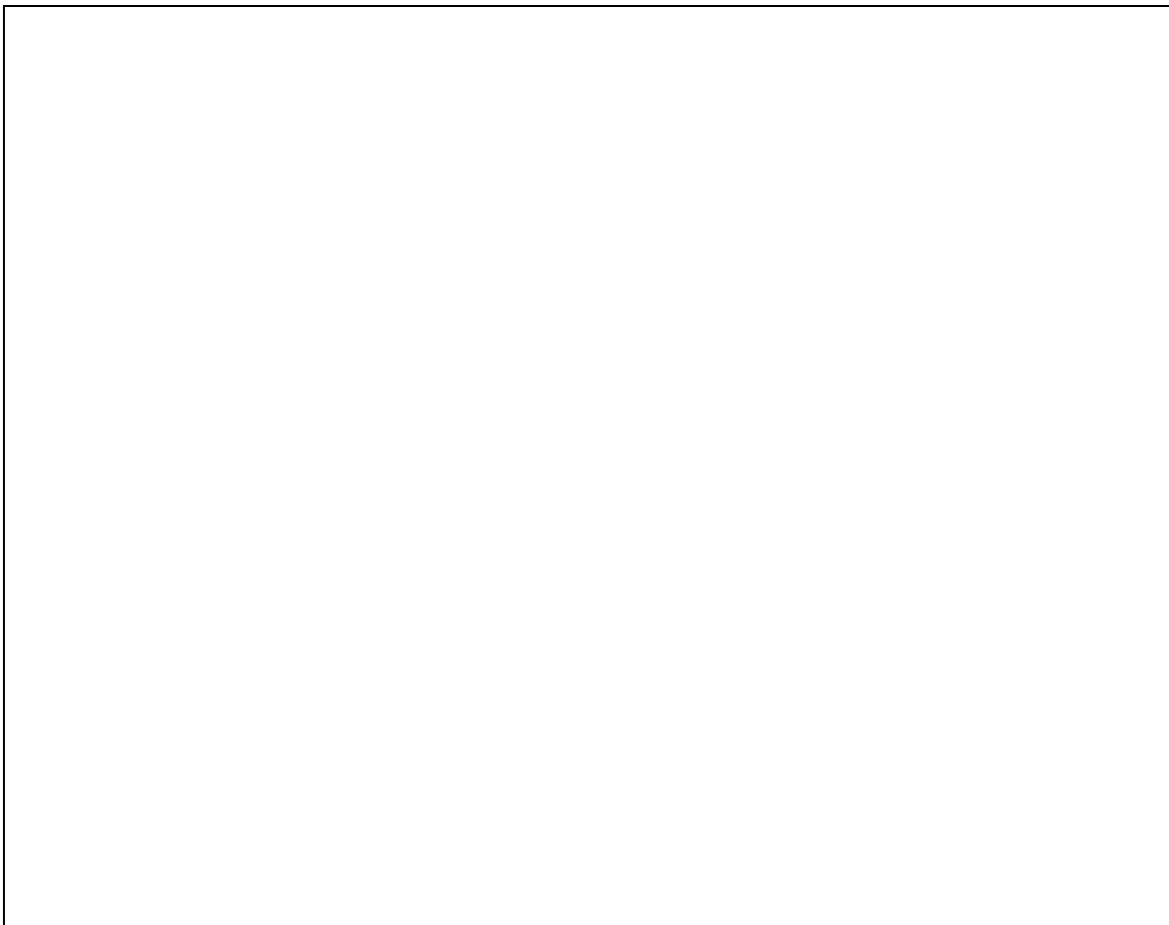
Section C: Long Question

		Marks
01	<p>A balanced three-phase source serves three loads, as follows:</p> <p>Load 1: 24 kW at 0.6 lagging power factor</p> <p>Load 2: 10 kW at unity power factor</p> <p>Load 3: 12 k at 0.8 leading power factor</p> <p>If the line voltage at the loads is 208 V at 50 Hz, determine the line current and the combined power factor of the loads.</p>	10

02	Power input to a 500 V, 50 Hz, 6 pole, 3-phase induction motor running at 975 rpm is 40 kW. The stator loss is 1 kW, friction and windage losses are 2 kW. Calculate (i) slip (ii) rotor copper loss (iii) efficiency	10
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03	<p>In the leakage test in a process industry, following results are observed</p> <p>Compressor capacity = 35 m³/min. Cut in pressure = 6.8 kg/ cm² (g) Cut out pressure = 7.5 kg/ cm² (g) Load drawn = 188 kW Unload kW drawn = 54 kW Average 'Load' time = 1.5 min. Average 'Unload' time = 10.5 min.</p> <p>Calculate the following:</p> <ol style="list-style-type: none"> i) Leakage quantity per day ii) Specific power for compressed air generation iii) Energy lost due to leakage/day 	10



04	<p>In an energy audit study of a cement plants following measurements are noted.</p> <table border="1" style="width: 100%; border-collapse: collapse;"><thead><tr><th style="width: 10%;">Pump ID</th><th style="width: 15%;">Measured flow, m³/h</th><th style="width: 15%;">Measured , kW</th><th style="width: 15%;">Operating head, m</th><th style="width: 15%;">Rated flow, m³/h</th><th style="width: 10%;">Rated head, m</th></tr></thead><tbody><tr><td style="text-align: center;">P1</td><td style="text-align: center;">12.31</td><td style="text-align: center;">42</td><td style="text-align: center;">357.0</td><td style="text-align: center;">15</td><td style="text-align: center;">380</td></tr><tr><td style="text-align: center;">P2</td><td style="text-align: center;">13.14</td><td style="text-align: center;">35</td><td style="text-align: center;">357.0</td><td style="text-align: center;">15</td><td style="text-align: center;">380</td></tr><tr><td style="text-align: center;">P3</td><td style="text-align: center;">21.60</td><td style="text-align: center;">55</td><td style="text-align: center;">362.25</td><td style="text-align: center;">25</td><td style="text-align: center;">380</td></tr></tbody></table> <p><i>Note: Motor efficiency is considered as 85%</i></p> <p>Evaluate the operating efficiency of the pumps and suitably replace the pumps with new pumps of efficiency 75%. What would be the annual reduction in energy consumption after implementation of the above measure?</p>	Pump ID	Measured flow, m ³ /h	Measured , kW	Operating head, m	Rated flow, m ³ /h	Rated head, m	P1	12.31	42	357.0	15	380	P2	13.14	35	357.0	15	380	P3	21.60	55	362.25	25	380	10
Pump ID	Measured flow, m ³ /h	Measured , kW	Operating head, m	Rated flow, m ³ /h	Rated head, m																					
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P3	21.60	55	362.25	25	380																					



05	Describe the step by step methodology of lighting system audit in a plant.	10

06	Name two types of transformer losses and write a brief note on this.	10

