

MURANG'A UNIVERSITY OF TECHNOLOGY SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

FOURTH YEAR **SECOND** SEMESTER EXAMINATION FOR BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING

EET 216: ELECTRICAL MACHINES

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

- 1. Answer Question one and any other two questions.
- 2. Mobile phones are not allowed in the examination room.
- 3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION QUESTION ONE (30 MARKS)

a)	State two advantages of three phase transformers over single phase transformers (2marks			
b)	A transformer has 600 primary turns and 150 secondary turns. The primary and			
	secondary resistances are 0.25 and 0.01respectively and corresponding leakage			
	reactances are 1.0 and 0.04 respectively. (7marks)			
	Determine			
	i) The e	equivalent resistance refereed to the primary w	rinding	
	ii) The e	The equivalent reactance referred to the primary winding		
	iii) The e	The equivalent impedance referred to the primary winding		
	iv) The phase angle of the impendence			
c)	Give two adv	vantages of three-phase squirrel cage induction	n motors over slip-ring	
	induction mo	otor.	(2marks)	
d)	A 440v, 60H	z, sox-pole, 3Ø induction machine is taking 50	Ok/va at 0.8 power factor and is	
	running at a	slip of 2.5. The stator copper losses are 0.5kW	and rotational losses are	
	2.5kW. Com	pute:	(5marks)	
	i) The t	otal copper loss		
	ii) The shaft HP			
	iii) The efficiency			
	iv) The shaft torque			
e)	A series motor has an armature resistance of 0.2 and a series field resistance of			
	0.3	It is connected to a 240V supply and at a	particular load runs at 24	
	revels when	drawing 15A from the supply.	(6marks)	
	i.	Determine the generated e.m.f. at this load.		
	ii.	Calculate the speed of the motor when the le	oad is changed such that the	
		current is increased to 30A. Assume that this	s causes a doubling of the flax.	
	iii.	Sketch and explain the speed/current characteristics	eteristic curve for the motor.	
f)	A shunt gene	erator supplies a 20kW lead at 200V though ca	ables of resistance,	
	R=100m	, as shown in fig QH. If the field windin	g resistance, R1=50and	
	the amateur resistance,			

Ra = 40m_____determine; i. The terminal voltage ii. The e.m.f. generated in the amature The efficiency of the generator at full load, assuming the iron, friction ad windage iii. losses amount to 1.2kW. SECTION TWO: ANSWER ANY TWO QUESTIONS **QUESTION TWO (20 MARKS)** a) What is amateur reaction and how is it minimized in a DC machine (2marks) **b**) With the aid of block diagram(s). Explain the construction and principle of operation of a DC machine (8marks) c) A 415V, three-phase 50Hz. 4 pole star-connected induction motor rans at 24 revis on full load. The motor resistance and reactance per phase are 0.35____ and 3.5_ respectively and the effective rator-stator turns ratio is 0.85:1. Calculate (10marks) i. The synchronous speed ii. The slip iii. The full load torque iv. The power output if mechanical losses amount to 770w The maximum torque v. vi. The speed at which maximum torque occurs, and vii. The starting torque **QUESTION THREE (20 MARKS)** a) Using diagrams, explain the principle of operation of a three phase inductor motor. (6marks) b) State and briefly explain two principal losses of a machine (4marks) c) The power supplied to a three-phase induction motor is 32kW and stator losses are 1200w. If the slip 1% determine (6marks) i. The rotor copper loss

The total mechanical power developed by the rotor

ii.

	iii.	The output power of the motor if friction and windage losses are 710w and		
	iv.	The efficiency of the motor, neglecting rotor iron loss.		
d)	d) A 500V shant motor runs at its normal speed of 10 rals when the amature current is			
	210A. The armature resistance is 0.2			
	i.	Determine the speed when the current is 60A and resistance of 0.5 is		
		connected in series with the amature, the shunt field remaining constant.		
	ii.	Determine the speed when the current is 60A and the shunt field is reduced to		
		80% of its normal value by increasing resistance in the field circuit.		
QUESTION FOUR (20 MARKS)				
	a)	Explain the principle of operation of a transformer (6marks)		
	b)	A $500V$ shunt motor runs at its normal speed of 10 revls when the armature current is		
		120A. The amature resistance is 0.2 Determine the speed when the current is		
		60A and a resistance of 0.5 is connected in series with the armature, the shunt		
		field remaining constant. (4marks)		
	c)	A 400kVA transformer has a primary winding resistance of 0.5 and a secondary		
		winding resistance of 0.001 The iron loss is 2.5kW and the primary and		
		secondary voltages are $5kV$ and $320v$ respectively of the transformer (a) on full load,		
		and (b) on half load. Determine also the maximum efficiency for this transformer		
		assuming the power factor remains unchanged. (10marks)		