Hall Ticket No: | | | | | | | | | | |

Question Paper Code: AEEB11

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER

B.Tech III Semester End Examinations (Regular), November – 2019

Regulation: IARE–R18

ELECTRICAL MACHINES – I

(Electrical and Electronics Engineering)

Time: 3 hours **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1	a)	Derive the expression for magnetic force and torque produced in a singly excited magnetic field system.	[7M]
	b)	The field winding of DC electromagnet is wound with 960 turns and has a resistance of 50Ω. The exciting voltage is 230V and the magnetic flux linking the coil is 5mWb. Determine (i) the self inductance of the coil and (ii) the energy stored in the magnetic field.	[7M]
2	a)	Derive the expression for magnetic force and torque produced in a doubly excited magnetic field system.	[7M]
	b)	A coil is wound on an iron core to form a solenoid and a current is passed through the coil which produces a flux of 40μWb. The length of the magnetic circuit is 75cm, while it's cross sectional area is 3sq.cm. Calculate (i) the energy stored per unit volume of the circuit and (ii) the total energy stored in the circuit.	[7M]

UNIT – II

3	a)	Explain the internal and external characteristics of DC shunt and DC series generators with neat sketches.	[7M]
	b)	Two DC generators have rectilinear external characteristics operating in parallel. One machine has the terminal voltage of 270V on no load and 220V at the load current of 30 A. The other has a voltage of 280V at no load and 220V at a load current of 30A. Calculate the output current and the bus voltage of each machine when the (i) Total load current is 50A and (ii) Load resistance is 10Ω.	[7M]
4	a)	Explain the process of commutation in DC generators with neat sketches and state the methods for improving the commutation.	[7M]
	b)	A 4 pole DC shunt generator with wave connected armature has 41 slots and 12 conductors per slot. The armature and field resistances are 0.5Ω and 200Ω respectively. When the generator is driven at a speed of 1000rpm, calculate the voltage across a load resistance of 10Ω connected across the armature terminals if the flux per pole is 125Wb.	[7M]

UNIT – III

5 a) Explain the principle of operation of DC motor and derive the expression for electromagnetic torque developed. [7M]

b) A 440 V DC shunt motor takes a no load current of 2.5A. The resistance of shunt field and the armature are 550Ω and 1.2Ω respectively. The full load line current is 32A. Find the full load output and the efficiency of the motor. [7M]

6 a) Explain the Swinburne's test to determine the no load losses of a DC machine and state the limitations. [7M]

b) A 6 pole, 250 V lap connected series motor has 240 slots with 4 conductors per slot. The flux per pole is 1.75×10^{-2} Wb when the motor is taking a current of 80A. The field resistance is 0.05Ω, armature resistance is 0.1Ω and the iron and frictional loss is 0.1 KW. Calculate (i) Speed (ii) BHP and (iii) Shaft torque [7M]

UNIT – IV

7 a) Define an ideal transformer. Draw and explain the phasor diagram of an ideal transformer. [7M]

b) The efficiency of a 1100KVA, 110/220V, 50Hz single phase transformer is 98.7% at full load 0.8 power factor leading and 98.9% at full load unity power factor. Determine (i) Iron loss (ii) Full load copper loss and (iii) Maximum efficiency at unity power factor. [7M]

8 a) Distinguish between core type and shell type transformers. Why the low voltage winding is placed near the core? [7M]

b) A single phase 200/400V, 6KVA, 50Hz transformer gave the following results. [7M]
OC test (LV side) : 200V, 0.8A, 80W
SC test (HV side) : 25V, 10A, 90W
Determine (i) The circuit constants referred to LV side and (ii) Efficiency at full load 0.8 lagging power factor.

UNIT – V

9 a) Explain the principle of operation of an auto transformer and state its merits and demerits over a two winding transformer. [7M]

b) A three phase step down transformer is connected to 6600 V on the primary side. The ratio of turns per phase is 12 and the line current drawn from the mains is 20A. Calculate the secondary line voltage and line current if the transformer is (i) Y-Y (ii) Y- Δ (iii) Δ-Y (iv) Δ-Δ connected. [7M]

10 a) Explain how a three phase supply is converted into two phase supply using two single phase transformers. [7M]

b) An auto transformer supplies 5KW unity power factor load at 125V. If the primary voltage is 250V, determine (i) Transformation ratio (ii) Primary and secondary currents (iii) Power transformed (iv) Power conducted directly from the supply mains to load. [7M]

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COURSE OBJECTIVES:

The course should enable the students to:

I	Understand the concepts of magnetic circuits and illustrate the theory of electromechanical energy conversion and the concept of co-energy
II	Understand the operation of DC machines
III	Analyze the differences in operation of different DC machine configuration
IV	Analyze single phase and three phase transformers circuits

COURSE OUTCOMES (COs):

I	Describe the basic concepts of electro-mechanical energy conversion, energy balance, energy stored in magnetic field, co-energy, single and multi excited systems
II	Discuss the working principle, losses, efficiency, characteristics and various tests of DC generator.
III	Analyze the working principle, losses, efficiency, characteristics and various tests of DC motor.
IV	Describe the working principle, EMF equation, phasor diagram, losses, efficiency, regulation, characteristics and various tests of single phase transformer.
V	Analyze the working principle, various connections of three phase transformer. Auto transformer, Scott connection, on load and off load tap changing transformer, cooling methods.

COURSE LEARNING OUTCOMES:

AEEB11.01	Describe the basic electromagnetic energy conversion process, energy storage and energy balance.
AEEB11.02	Solve simple and complex problems related to electromagnetic circuits.
AEEB11.03	Derive the force and torque produced in singly excited, multi excited magnetic systems.
AEEB11.04	Outline the construction, operation, windings used, concept of armature reaction, commutation and types of DC generators.
AEEB11.05	Discuss the characteristics, losses, regulation, efficiency, characteristics and applications of DC generators.
AEEB11.06	Examine the parallel operation of DC generators, importance of equalizer bars and load sharing
AEEB11.07	Study the operation, construction, significance of back EMF, torque, characteristics and speed control methods of DC motors.
AEEB11.08	Classify the different types of losses, condition for maximum power and efficiency and starters used for DC motors.
AEEB11.09	Determine the efficiency of DC machines by conducting direct and indirect tests.
AEEB11.10	Discuss the principles of operation, construction, types, EMF equation and equivalent circuit of single phase transformers.
AEEB11.11	Explain the operation of single phase transformer under no-load and on-load along with its phasor diagrams.
AEEB11.12	Calculate the efficiency and regulation of single phase transformers by conducting different tests.
AEEB11.13	Examine the parallel operation of single phase transformers and analyze the load sharing.
AEEB11.14	Explain the operation, construction and different types of connections of three phase transformers.
AEEB11.15	Demonstrate the operation of open delta connection and Scott connection with two single phase transformers and tap changing transformer.
AEEB11.16	Explain the functioning of autotransformers, tap changing transformers and off-load, on-load tap changers.

AEEB11.17	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations

MAPPING OF MODEL QUESTION PAPER QUESTIONS TO THE ACHIEVEMENT OF COURSE OUTCOMES

SEE QUESTION No.		COURSE OUTCOMES		Course Outcomes	BLOOM TAXONOMY LEVEL
1	a	AEEB11.04	Derive the force and torque produced in singly excited, multi excited magnetic systems.	CO 1	Remember
	b	CEE004.03	Describe the basic electromagnetic energy conversion process, energy storage and energy balance.	CO 1	Understand
2	a	AEEB11.04	Derive the force and torque produced in singly excited, multi excited magnetic systems.	CO 1	Understand
	b	AEEB11.03	Describe the basic electromagnetic conversion process, energy storage and energy balance.	CO 1	Understand
3	a	AEEB11.05	Outline the construction, operation, characteristics and applications of different types of DC generators.	CO 2	Remember
	b	AEEB11.07	Examine the parallel operation of DC generators and load sharing.	CO 2	Understand
4	a	AEEB11.05	Outline the construction, operation, characteristics and applications of different types of DC generators.	CO 2	Understand
	b	AEEB11.05	Outline the construction, operation, characteristics and applications of different types of DC generators.	CO 2	Understand
5	a	AEEB11.08	Demonstrate the working and speed control of different types of DC motors.	CO 3	Remember
	b	AEEB11.10	Determine the efficiency of DC machine by conducting direct and indirect tests.	CO 3	Understand
6	a	AEEB11.10	Determine the efficiency of DC machine by conducting direct and indirect tests.	CO 3	Understand
	b	AEEB11.08	Demonstrate the working and speed control of different types of DC motors.	CO 3	Understand
7	a	AEEB11.11	Discuss the principle of operation and construction of single phase transformers.	CO 4	Understand
	b	AEEB11.12	Calculate the efficiency and regulation of single phase transformers by conducting different tests.	CO 4	Understand
8	a	AEEB11.11	Discuss the principle of operation and construction of single phase transformers.	CO 4	Understand
	b	AEEB11.12	Calculate the efficiency and regulation of single phase transformers by conducting different tests.	CO 4	Remember
9	a	AEEB11.14	Summarize the different types of connections of three phase transformers.	CO 5	Understand
	b	AEEB11.15	Explain the functioning of autotransformers, tap changing transformers and off load and on load tap changers.	CO 5	Understand
10	a	AEEB11.14	Summarize the different types of connections of three phase transformers.	CO 5	Understand
	b	AEEB11.15	Explain the functioning of autotransformers, tap changing transformers, off load and on load tap changers.	CO 5	Understand

Signature of Course Coordinator **HOD, EEE**