Techno India NJR Institute of Technology

Course File

Basic Electrical Engineering (1FY3-08)

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For Techno India NJR Institute of Technology
पंकज पोरवाल
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Syllabus:

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

I & II Semester

Common to all branches of UG Engineering & Technology

1FY3-08/ 2FY3-08: Basic Electrical Engineering

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	**DC Circuits:** Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, Series-Parallel circuits, Node voltage method, Mesh current method, Superposition, Thevenin's, Norton's and Maximum power transfer theorems.	5
2	**AC Circuits:** Representation of sinusoidal waveforms, peak and r.m.s values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase AC circuits consisting of R, L, C, RL, RC and RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.	4
3	**Transformers:** Ideal and practical transformer, EMF equation, equivalent circuit, losses in transformers, regulation and efficiency.	4
4	**Electrical Machines:** Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Starting and speed control of induction motor, single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited DC motor. Construction and working of synchronous generators.	7
5	**Power Converters:** Semiconductor PN junction diode and transistor (BJT). Characteristics of SCR, power transistor and IGBT. Basic circuits of single phase rectifier with R load, Single phase Inverter, DC-DC converter.	4
6	**Electrical Installations:** Layout of LT switchgear: Switch fuse unit (SFU), MCB, ELCB, MCCB, Type of earthing. Power measurement, elementary calculations for energy consumption.	4
	TOTAL	28

Course Overview:

This course is mainly for undergraduate First-Year Engineering students from all Specializations. This course will introduceand explain the fundamental concepts of basic electrical engineering in 29-hours. The basic concepts of DC and AC (Single Phase and Three Phase Circuits) network analysis, first order DC transients, steady state and phasor analysis of AC networks, series and parallel resonance and magnetic coupled circuits. This course will also cover Single Phase Transformers, Single and Three Phase Induction Machines and DC Machines. This also includes the Power converter concepts ans analysis of single phase full wave rectifier using R load and Electrical installations in substations. By the end of the course, the students should be able to gather high-quality knowledge of basic electrical engineering as well as the practical implementation of fundamental theory concepts.

Course Outcome:

CO. NO.	Cognitive Level	Course Outcome
1	Synthesis	The student will be able to arrange and reconstruct for solving circuit with different kind of methods and theorems.
2	Synthesis	The student will be able to summarize and explain the behaviours of basic electrical elements like resistor, inductor and capacitor.
3	Analysis	Students will be able to categorize and formulate the behaviours of transformer.
4	Analysis	The students will be able to analyze behaviours, Categorize and relate the concept of AC and DC machines.
5	Application	The students will be able to assemble electronics components and prepare the circuit after formulate its properties. Summarize and relate the behaviour of LT switchgear, earthing and electrical power measurement

Prerequisites:

1. Fundamentals of current electricity.
2. Students should be efficient in basic mathematics and solving an algebraic equation.
3. Students should be able to perform basic exponential, trigonometric and logarithmic operations.

Course Outcome Mapping with Program Outcome:

Course Outcome	Program Outcomes (PO's)											
CO. NO.	Domain Specific (PSO)					Domain Independent (PO)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	1	-	2	-	1	-	-	-	1
CO2	1	2	1	2	-	-	-	-	-	-	-	1
CO3	2	1	1	1	-	1	-	-	-	-	-	1
CO4	2	1	1	1	1	-	-	-	-	-	-	1
CO5	2	1	1	1	1	-	-	-	-	-	-	1
1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)												

Course Coverage Module Wise:

Lect. No.	Unit	Topic
1	1	**DC CIRCUITS:** Fundamentals of circuits elements (R, L and C).
2	1	Real-life resistors, capacitors and inductors and Understanding of voltage and current sources.
3	1	Kirchhoff current and voltage laws for circuit solving.
4	1	Series-Parallel circuits using the resistors, capacitor and inductors.
5	1	Node voltage method and Mesh current method for circuit solution.
6	1	Analysis using Superposition, Thevenin"s, Norton"s and Maximum power transfer theorems.
7	2	**AC CIRCUITS:** Representation of sinusoidal waveforms.
8	2	Calculating peak and r.m.s values and phasor representation.
9	2	Concept of real power, reactive power, apparent power, power factor and their calculations and significance.
10	2	Analysis of single-phase AC circuits consisting of R, L, C, RL, RC and RLC combinations (series and parallel).
11	2	Resonance in circuits and three phase balanced circuits, voltage and current relations in star and delta connections.
12	3	**TRANSFORMERS:** Differences between Ideal and practical transformer.
13	3	Transformer EMF equation analysis and equivalent circuit.
14	3	Measuring losses in transformers.
15	3	Perform therotical calculation for transformer regulation and efficiency.

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16	4	**ELECTRICAL MACHINES:** Fundamentals of electromagnetism and Generation of rotating magnetic fields.
17	4	Construction and working of a three-phase induction motor.
18	4	Significance of torque-slip characteristic.
19	4	Starting and speed control of induction motor.
20	4	Single phase induction motor. Construction, working, torque-speed characteristic
21	4	Speed control of separately excited DC motor
22	4	Construction and working of synchronous generators.
23	5	**POWER CONVERTERS:** Semiconductor PN junction diode and transistor (BJT) construction and working.
24	5	Contruction, working and characteristics of SCR, power transistor and IGBT.
25	5	Basic circuits analysis of single phase rectifier with R load.
26	5	Single phase Inverter contruction and application, DC-DC converter working and analysis.
27	6	**ELECTRICAL INSTALLATIONS:** Fundamentals of power system generation, transmission and distribution.
28	6	Basic Layout of LT switchgear and Switch fuse unit (SFU).
29	6	Contruction, working and application of MCB, ELCB and MCCB.
30	6	Type of earthing, Power measurement, elementary calculations for energy consumption.

Text/Reference Books:

1. Circuit theory (Analysis and Synthesis) by A. Chakrabarti-Dhanpat Rai&Co.
2. Network Theory by Prof.B.N.Yoganarasimham.
3. Circuit Theory by Sudhakar and ShyamMohan.
4. Electrical Machines-I by B.I.Theraja

Teaching and Learning resources:

NPTEL Course Link	https://onlinecourses.nptel.ac.in/noc19_ee35/preview
Quiz	https://www.yourelectricalguide.com/basic-electrical-quiz-questions-with-answers https://www.sanfoundry.com/1000-basic-electrical-engineering-questions-answers/ https://www.electrical4u.com/electrical-engineering-objective-questions-mcq/
Notes	https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/ https://www.electrical4u.com/electrical-engineering-articles/electrical-laws/ https://www.electrical4u.com/electrical-engineering-articles/circuit-theory/

Assessment Methodology:

1. Assignments one from each unit.
2. Midterm subjective paper where they have to solve the given problem. (Twice during the semester)
3. Final paper at the end of the semester subjective

Previous Year Question Paper:

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1E2408

Roll No. _____ Total No of Pages: 4

1E2408

B. Tech. I - Sem. (Main/Back) Exam., Dec. 2019

1FY1 – 08 Basic Electrical Engineering

Time: 2 Hours **Maximum Marks: 80**

Min. Passing Marks: 28

Instructions to Candidates:

Attempt all five questions from Part A, four questions out of six questions from Part B and two questions out of three from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. Scientific Calculator 2. NiL

PART – A

(Answer should be given up to 25 words only) **[5×2=10]**

All questions are compulsory

Q.1 Explain the concept of voltage and current source transformation with an example.

Q.2 What is meant by power factor of an AC circuit? What is its minimum value and its maximum value?

Q.3 What is eddy current loss and how can this loss be reduced?

Q.4 What is meant by slip of an induction motor?

Q.5 Distinguish between a Rectifier and an Inverter.

PART – B

(Analytical/Problem solving questions) **[4×10=40]**

Attempt any four questions

Q.1 Find the current through 3Ω Resistor in the circuit shown in Figure 1. by using Thevenin's theorem.

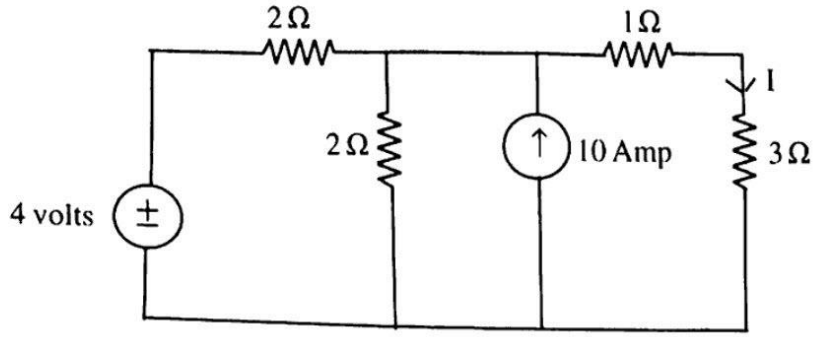

Figure - 1

Q.2 For the circuit shown in Figure. 2. determine the voltages at nodes B and C and calculate the current through the 8Ω resistor.

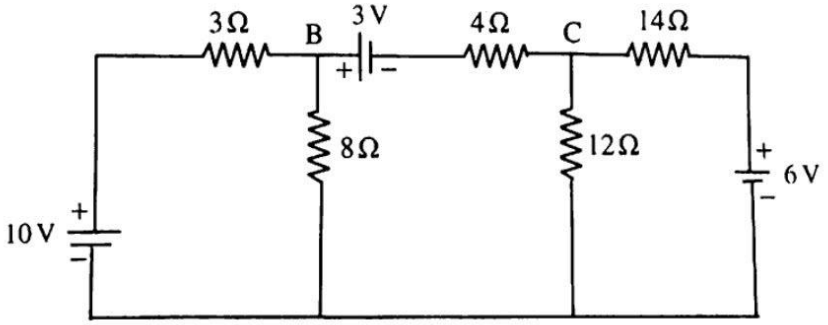

Figure - 2

Q.3 A voltage wave has the variation as shown in figure 3. Determine –

(a) The average and RMS value of voltage.

(b) If the voltage of part (1) is applied to a 50 Ω resistor. Find the power dissipated in watts.

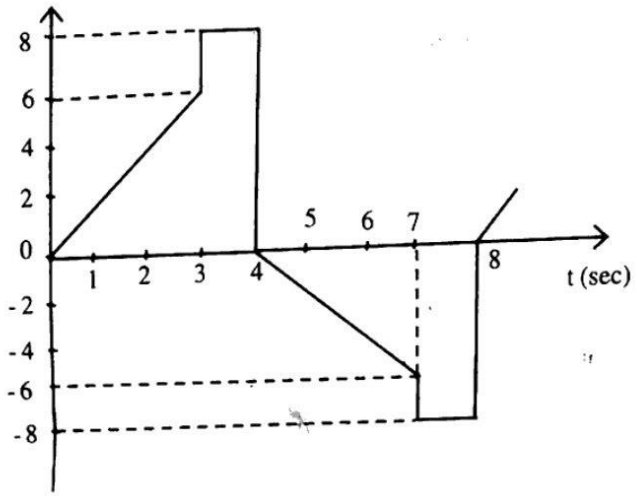

Figure - 3

Q.4 Derive EMF equation of single phase transforms. Also explain that why transformer is known as constant flux device.

Q.5 Explain in detail the construction and principle of working of a three – phase Induction motor.

Q.6 Explain the working of a single – phase full bridge Inverter with the help of circuit diagram and output voltage waveform.

PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) **[2×15=30]**

Attempt any two questions

Q.1 (a) A non – inductive resistance of 10Ω is connected in series with an inductive coil across 200V, 50 Hz a.c. supply. The current drawn by the series combination is 10 A. The resistance of the coil is 2Ω. Design a circuit first and then calculate inductance of the coil, power factor of the coil, Power factor of the circuit and voltage across the coil.

(b) Distinguish between active powers, reactive power and apparent power with the help of power triangle.

Q.2 (a) What is a SCR? Sketch static I –V characteristics of a thyristor. Label the various voltages, currents and the operating modes on this sketch.

(b) Explain the torque – speed characteristic and speed control of separately excited DC motor.

Q.3 (a) Why protective devices are used for overload and short – circuit protections? Why do we use an ELCB in an electrical installation?

(b) Calculate the energy consumed per month by the following loads –

(i) 4 tube lights of 40 W used on an average of 8 hours per day.

(ii) 3 fans of 8 W used on an average of 10 hours per day.

(iii) 1 fridge of ¼ kW rating operating 12 hours per day.

The supply voltage is 230V, 50 Hz. Also calculate the electricity bill if cost of one unit of energy is ₹ 5/- only.
