MECHANICAL

DEPARTMENT

2022-23

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PREPARED BY

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Course File

Digital Electronics (4ME3-04)

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4ME3-04: DIGITAL ELECTRONICS

Credit: 2 | Max. Marks: 100 (IA:20, ETE:80)
2L+0T+0P | End Term Exam: 2 Hours

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Semiconductor Devices and Applications:** Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.	4
3	**Operational amplifier and its applications:** Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.	5
4	**Timing Circuits and Oscillators:** RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.	5
5	**Digital Electronics Fundamentals:** Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.	6
6	**Electronic Communication Systems:** The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.	5
	TOTAL	26

Course Overview:

Digital electronics is a field of electronics involving the study of digital signals and the engineering of devices that use or produce them. Digital electronic circuits are usually made from large assemblies of logic gates, often packaged in integrated circuits.

Course Outcomes:

CO.NO.	Cognitive Level	Course Outcome
1	**Comprehension**	Basic knowledge of the fundamental concepts and techniques used in digital electronics.
2	**Application**	Understand and examine the structure of various number systems and its application in digital design.
3	**Analysis**	Understand, analyze and design various combinational and sequential circuits.
4	**Synthesis**	Identify basic requirements for a design application and propose a cost effective solution.
5	**Evaluation**	Identify and prevent various hazards and timing problems in a digital design.

Prerequisites:

1. Fundamentals knowledge of number system.
2. Fundamentals knowledge of semiconductor physics.

Course Outcome Mapping with Program Outcome:

Course Outcome	Program Outcomes (PO's)											
CO. NO.	Domain Specific					Domain Independent						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	0	0	1	0	0	0	0	1	0
CO2	1	1	1	2	0	0	2	0	0	0	0	0
CO3	2	1	2	1	1	1	0	0	0	0	1	1
CO4	1	1	2	1	1	0	0	0	0	0	1	0
CO5	1	1	2	1	1	0	0	0	0	0	1	0
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

Course Coverage Module Wise:

Lecture No.	Unit	Topic
1	**1**	**INTRODUCTION:** Objective, scope and outcome of the course.
2	**2**	**SEMICONDUCTOR DEVICES & APPLICATIONS:** Introduction to P-N junction Diode, P-N junction Diode and V-I characteristics
3	2	Half wave rectifier, Analysis of half wave rectifier, Full wave rectifier, Analysis of full wave rectifier
4	2	capacitor filter, Zener diode, Zener diode characteristics, Zener diode as voltage regulator, Regulated power supply IC
5	2	Introduction to BJT, BJT input-output and transfer characteristics BJT as a single stage CE amplifier, frequency response and bandwidth.
6	2	**OPERATIONAL AMPLIFIER & IT'S APPLICATIONS:** Introduction to operational amplifiers
7	**3**	**OPERATIONAL AMPLIFIER & IT'S APPLICATIONS:** Introduction to operational amplifiers
8	3	Op-amp input modes, Op-amp parameters
9	3	Op-amp in open loop configuration, Op-amp with negative feedback
10	3	Study of practical op-amp IC 741
11	3	Inverting amplifier, Non-inverting amplifier
12	3	Applications of op- amp: summing, Difference amplifier, Unity gain buffer
13	3	Comparator, Integrator, Differentiator
14	**4**	**TIMING CIRCUIT AND OSCILLATORS:** RC-timing circuits
15	4	IC 555 and its applications as a stable multi-vibrator and mono stable multi-vibrator
16	4	Positive feedback, Barkhausen's criteria for oscillation
17	4	R-C phase shift oscillator, Wein bridge oscillator.
18	5	**DIGITAL ELECTRONICS FUNAMENTALS:** Difference between analog and digital signals
19	5	Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map
20	5	Logic ICs, Half adder/subtractor, Full adder/subtractor

21	5	Multiplexers, De- multiplexers, flip-flops, Shift registers, Counters
22	5	Block diagram of microprocessorand microcontroller their applications
23	**6**	**ELECTRONIC COMMUNICATION SYSTEMS:** The elements of communication system, IEEE frequency spectrum
24	**4**	Transmission media: wired and wireless, Need of modulation
25	**4**	AM modulation schemes, FM modulation schemes
26	4	Mobile communication systems: cellular concept Block diagram of GSM system.

TEXT/REFERENCE BOOKS

1. Microelectronic Circuits – Theory and Applications, Adel S Sedra, Kenneth C Smith and Arun N Chandorkar, Oxford University Press
2. Digital Circuit & Logic Design, Morris Mano, Prentice Hall of India.
3. Principles of Communication Systems, Herbert Taub, Donald Schilling, Goutam Saha, TMH

NPTEL COURSES LINK

https://swayam.gov.in/explorer?searchText=digital+circuit

QUIZ Link

https://rank.sanfoundry.com/digital-circuits-tests/

Faculty Notes Link

https://drive.google.com/drive/u/1/folders/1k847o1TsCeeXGypfpe-deKl11l1AHvBB

Assessment Methodology:

1. Practical exam using Multisim software.
2. Two Midterm exams where student have to showcase subjective learning.
3. Final Exam (subjective paper) at the end of the semester.

4E1309

Roll No. _____ Total No. of Pages: 3

4E1309

B. Tech. IV - Sem. (Main) Exam., - 2022

Automobile Engineering

4AE3-04 Digital Electronics

AE, ME

Time: 3 Hours **Maximum Marks: 70**

Instructions to Candidates:

Attempt all ten questions from Part A. Five questions out of seven questions from Part B and three questions out of five 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. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only) **[10×2=20]**

All questions are compulsory

Q.1 Draw the VI characteristic of an ideal diode.

Q.2 State Mass – action law and give its equation.

Q.3 What is Hall Effect?

Q.4 Define slew rate and SVRR.

Q.5 Design a NOT gate using two input Ex – OR gate.

Q.6 Simplify following Boolean expression –

$$(P + \overline{Q})\,(P\overline{Q} + PR)\,(\overline{P}\,\overline{R} + \overline{Q})$$

Q.7 What is the 11's compliment of $(935)_{12}$.

Q.8 State Barkhausen's criteria for oscillation.

Q.9 What is the need of modulation?

Q.10 What is the difference between positive and negative feedback?

PART – B

(Analytical/Problem solving questions) **[5×4=20]**

Attempt any five questions (Word limit 100)

Q.1 Draw & explain the V – I characteristic of P – N diode. Also explain the dependence of V-I characteristic on temperature with suitable equation.

Q.2 Draw the circuit of transistor in common emitter configuration & sketch the output characteristic, mention cutoff, active and saturation region also.

Q.3 Calculate the output voltage for circuit shown below –

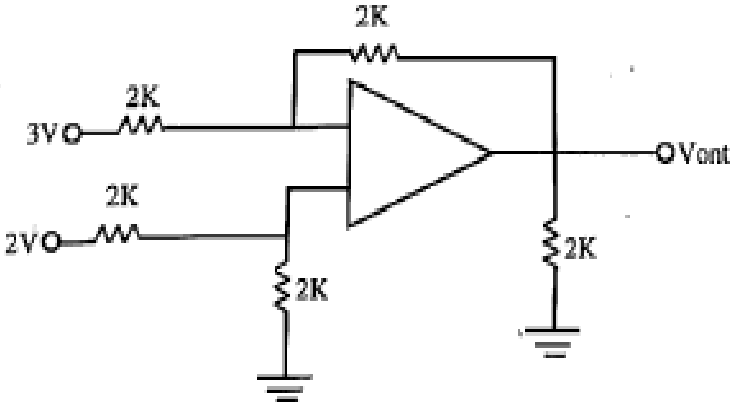

Figure – 1

Q.4 Draw the circuit diagram for an integrator and also explain its working.

Q.5 Implement the following Boolean function with only one 4.1 multiplexer -

$F(A, B, C) = \sum (1, 3, 5, 7)$

Q.6 State the difference between latch and flip flop using suitable diagram.

Q.7 Minimize $F(x, y, z) = \sum (0, 2, 3, 4, 6) + d(1, 5)$ using K Map

PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) **[3×10=30]**

Attempt any three questions

Q.1 Design the full adder circuit using NAND gate.

Q.2 Design the regulated power supply of ± 5V using filters and three terminal voltage regulated IC. Also mention the capacitor value for filtering.

Q.3 What are the various operating modes of SSS IC? Explain the working principle of free running multivibrator also.

Q.4 Draw an asynchronous 4 – bit up down counter and also explain its working.

Q.5 Write short note on following –

(a) AM & FM modulation schemes

(b) IEEE frequency spectrum
