G. NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE
(for women)
Shaikpet, Hyderabad – 500 104

II B.Tech I Sem ETM (2022-2026 Batch)
Mid Marks Analysis for the Academic Year 2023-2024
Electronic Devices and Circuits

Mid 1
Slow Learners (≤14) : 7
Advanced Learners (≥30 out of) 35):2

S.No	Roll No.	Marks
1	22251A1705	14
2	22251A1713	10
3	22251A1719	12
4	22251A1739	13
5	22251A1740	13
6	22251A1758	14
7	23255A1707	14
8	22251A1711	30
9	22251A1714	31

Mid 2
Slow Learners (≤14): NIL
Advanced Learners (≥30 out of 35):17

S.No.	Roll No.	Marks
	22251A1711	30
1	22251A1712	33
2	22251A1714	34
3	22251A1721	33
4	22251A1731	30
5	22251A1738	31
6	22251A1741	31
7	23255A1742	30
8	22251A1748	30
9	22251A1750	30
10	22251A1751	31
11	22251A1759	33
12	22251A1761	31
13	22251A1762	30
15	22251A1763	31
16	22251A1764	31
17	23255A1701	32

Improvement from Mid 1 to Mid 2

S. No.	Roll No.	MID – I Marks	MID – II Marks
1.	22251A1701	21	28
2.	22251A1703	16	29
3.	22251A1704	24	25
4.	22251A1707	21	29
5.	22251A1709	18	20
6.	22251A1710	18	20
7.	22251A1712	28	33
8.	22251A1713	10	23
9.	22251A1714	31	34
10.	22251A1715	17	22
11.	22251A1717	18	20
12.	22251A1718	20	26
13.	22251A1719	12	15
14.	22251A1720	15	25
15.	22251A1721	25	33
16.	22251A1722	20	29
17.	22251A1724	19	24
18.	22251A1726	22	26
19.	22251A1727	23	27
20.	22251A1728	24	28

21.	22251A1729	20	28
22.	22251A1730	21	29
23.	22251A1731	26	30
24.	22251A1732	23	29
25.	22251A1733	15	28
26.	22251A1734	19	28
27.	22251A1735	20	23
28.	22251A1736	20	23
29.	22251A1737	22	29
30.	22251A1738	25	31
31.	22251A1739	13	22
32.	22251A1740	13	22
33.	22251A1741	20	31
34.	22251A1742	25	30
35.	22251A1743	18	22
36.	22251A1744	19	19
37.	22251A1745	23	26
38.	22251A1746	19	27
39.	22251A1747	19	25
40.	22251A1748	25	30
41.	22251A1749	18	20
42.	22251A1750	28	30
43.	22251A1751	23	31
44.	22251A1752	15	19
45.	22251A1754	17	21
46.	22251A1755	17	21
47.	22251A1756	18	23
48.	22251A1757	17	24
49.	22251A1758	14	20
50.	22251A1759	26	33
51.	22251A1760	22	28

52.	22251A1761	22	31
53.	22251A1762	28	30
54.	22251A1763	23	31
55.	22251A1764	18	31
56.	23255A1701	22	32
57.	23255A1702	26	27
58.	23255A1703	18	23
59.	23255A1704	22	25
60.	23255A1705	16	27

G. NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE (For Women)

(AUTONOMOUS)

Shaikpet, Hyderabad, Telangana

DEPARTMENT OF ELECTRONICS AND TELEMATICS ENGINEERING

Program Name:	B. Tech (ETE)	**AY:**	2023 – 2024
Course Name, Code:	Electronic Devices and Circuits, 123AR	**Class / Sem:**	II/IV B. Tech, I Sem
Faculty Name:	Dr.T.Sunitha	**Instruction Period:**	11-09-2023 to 13-01-2024

Lecture no	Topic	Book/Web References	Teaching Method(s)
	Unit- I: P-N Junction Diode		
1.	P-N Junction as a Diode, Diode Equation	TB1,W1,W3	C&T
2.	VI characteristics, Temperature dependence of VI characteristics	TB1,W1,W4	C&T
3.	Ideal vs practical -Resistance levels (Static & Dynamic), related problems, Equivalent circuits, Load line analysis	TB1,W3,W5	C&T
4.	Transition Capacitance, related problems	TB1,W5	C&T
5.	Diffusion Capacitance, related problems	TB1,W5	C&T
6.	Breakdown Mechanism in Semiconductor Diodes	TB1,W5	C&T
7.	Zener Diode Characteristics	TB1,W4,W5	C&T
8.	Zener Diode as a Regulator, related problems	TB1,W3,W4	C&T
9.	Tunneling Phenomenon	TB2,RB1	C&T
10.	**Rectifiers:** P-N junction as a rectifier - Half Wave Rectifier	TB1& RB1,W3	C&T
11.	Ripple Factor - Full Wave, Bridge Rectifiers	TB1& RB1,W3	C&T
12.	Filters- Inductive, Capacitive	TB1& RB1,W5	C&T,S/P
13.	Filters - L and π section	TB1& RB1,W5	C&T,S/P
14.	Problems related to rectifiers	TB1& RB1	C&T
15.	*Revision & Review of previous question papers*		C&T
	Unit- II: Bipolar Junction Transistor		
16.	Construction, Principle of Operation, Symbol	TB1,W3,W4	C&T
17.	Transistor as an Amplifier	TB1,W3	C&T
18.	Common Base Configuration, characteristics	TB1,W1,W5	C&T
19.	Common Emitter Configuration, characteristics	TB1,W3,W4	C&T
20.	Common Collector Configuration, characteristics	TB1,W1	C&T,Q
21.	Problems related to transistor configurations		C&T
22.	**Transistor Biasing and Stabilization:** Operating Point, The DC Load Line Analysis	RB1,W1	C&T
23.	The AC Load line Analysis, Problems related to DC and AC Load lines	RB1,RB5	C&T
24.	Need for Biasing, Fixed Bias, Emitter Feedback Bias	RB2,W5	C&T
25.	Common Emitter Feedback bias	RB2,W5	C&T
26.	Voltage Divider Bias, related problems	RB1,W5	C&T
27.	Bias stability, Stabilization against variations in V_{BE} and β	RB3,W5	C&T
28.	*Revision & Review of previous question papers*		C&T

	Unit- III: Small Signal Low Frequency Model of BJT		
29.	BJT Hybrid Model	RB4,W4	C&T
30.	Determination of h-parameters from Transistor Characteristics	TB1,TB2	C&T
31.	Problems related to h-parameters	TB1,W4,W5	C&T
32.	Simplified CE Hybrid Model	TB1,W4,W5	C&T,ASG
33.	CC amplifier analysis using Approximate Model	TB1,W4,W5	C&T,S/P
34.	CB amplifier analysis using Approximate Model	TB1,W4,W5	C&T,S/P
35.	Single Stage - CB, CE, CC Amplifiers	TB1,W4,W5	C&T
36.	low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors	TB1,W4,W5	C&T
37.	Comparison of CB,CE,CC Amplifier configurations	TB1,W4,W5	C&T
38.	*Revision &Review of previous question papers*		C&T
	Unit- IV: Field Effect Transistor		
39.	The Junction Field Effect Transistor (Construction, principle of operation, symbol), Pinch-off Voltage, Volt-Ampere characteristics	TB2,W5	C&T
40.	JFET Small Signal Model, related problems	TB2,W5	C&T
41.	Biasing FET (Fixed bias, Self-Bias)	TB2,W5	C&T
42.	MOSFET (Construction, operation, symbol)	TB2,W2,W3,W4	C&T
43.	MOSEFT Characteristics in Enhancement mode, Depletion mode,	TB2,W2,W3,W4	C&T
44.	Comparison of BJT & FET	TB2,W5	C&T
45.	*Revision & Review of previous question papers*		S/P
	Unit- V: Positive & Negative Feedback in Amplifiers		
46.	Classification of amplifiers	TB1,W5	C&T
47.	Concepts of feedback – Classification of feedback amplifiers	TB1,RB5	C&T
48.	General characteristics of negative feedback amplifiers, Effect of Feedback on Amplifier characteristics	TB1,RB5	C&T
49.	Voltage series, Voltage shunt Feedback configurations-related problems	TB2& RB1	C&T
50.	Current series, Current shunt Feedback configurations-related problems	TB2& RB1	C&T
51.	Barkhausen criterion, Condition for oscillations RC type Oscillator	TB2& RB1	C&T
52.	RC-phase shift oscillator, Wien-bridge oscillator	TB2& RB1	C&T
53.	Condition for oscillations LC type Oscillator	TB2& RB1,W1	C&T
54.	Generalized analysis of LC oscillators	TB2& RB2	C&T
55.	LC oscillators (Hartley), LC oscillators (Colpitts)	TB2&RB3	C&T
56.	Crystal oscillators	TB2&TB2	C&T,ASG
57.	*Revision & Review of previous question papers*		C&T
58.	**Content beyond the syllabus**: Uni-Junction Transistor and its applications	W1	C&T

C & T – Chalk & Talk, S/P – Slides/PPT, V – Videos, SEM – Seminar, D – Demo, CHART, ET/ GL – Expert Talk/ Guest Lecture, Q – QUIZ, CPS – Classroom Problem Solving, GD – Group Discussion, RTCS – Real Time Case Studies, JAR – Journal Article Review, PD – Poster Design, OL – Online Lecture/ Google Classroom, IV – Industrial Visit, ASG – Assignment, Q – Quiz/ Puzzle, BS – Brain Storming, TPS – Think Pair Share, CERT – Certification, SIM – Simulation, P/G – Pledge/ Greeting, Q/R – Quotes/ References, LS – Literature Survey, RW – Report Writing, MM – Model Making, PED – Professional/ Ethical Dilemma, Coding, Activity/ Event, FV – Field Visit etc.

Text / Reference Books:

1. J.Millman, C.C.Halkias, and SatyabrathaJit, Electronic Devices and Circuits, 2nd Edition, Tata McGraw Hill, 2007.
2. R.L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits, 9th Edition, Pearson/Prentice Hall, 2006.

Reference Books:

1. G. Streetman, and S. K. Banerjee, Solid State Electronic Devices, 7th Edition, Pearson, 2014.
2. Millman , Christos Halkias, Chetan D Parikh Integrated Electronics, 2nd Edition, Tata McGraw Hill, 2011.
3. S.G.Burns and P.R.Bond, Principles of Electronic Circuits, 2nd Edition, Galgotia Publications, 1998.
4. C.T. Sah, Fundamentals of Solid State Electronics, World Scientific Publishing Co. Inc,1991.
5. T.F. Bogart Jr., J.S.Beasley and G.Rico, Electronic Devices and Circuits, 6th Edition, Pearson Education, 2004.

Web References:

W1: 1. https://nptel.ac.in/courses/117/103/117103063/
W2: 2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=uUIVj2W71X+8mppiIHe0+A==
W3: 3. https://www.coursera.org/learn/electronics#modules
W4: 4. https://www.ee.iitb.ac.in/~sequel/course_material.html
W5: 5. https://a.impartus.com/ilc/#/course/2959661/990

Signature of the Faculty

Date: 4/9/23

Signature of the HOD

G.NARAYANAMMA INSTITUTE OF TECHNOLOGY AND SCIENCE

(AUTONOMOUS) FOR WOMEN

SHAIKPET, HYDERBAD-500104

ACADEMIC CALENDAR (2023-2024)

II B. Tech-I Sem

Commencement of 1st Semester Class Work	11-09-2023
1st Spell of Instructions	11-09-2023 To 11-11-2023 (9 Weeks)
Dussehra Holidays	22-10-2023 To 28-10-2023(1 Week)
First Mid Term Examinations	13-11-2023 To 18-11-2023 (1 Week)
2nd Spell of Instructions	20-11-2023 To 13-01-2024 (8 Weeks)
Second Mid Term Examinations	17-01-2024 To 21-01-2024 (1 Week)
Preparation & Practical Examinations	22-01-2024 To 27-01-2024 (1 Week)
End Semester Examinations	29-01-2024 To 10-02-2024 (2 Weeks)

II B. Tech-II Sem

Commencement of 2nd Semester Class Work	**19-02-2024**
1st Spell of Instructions	19-02-2024 TO 13-04-2024 (8 Weeks)
First Mid Term Examinations	15-04-2024 TO 20-04-2024 (1 Week)
2nd Spell of Instructions	22-04-2024 TO 15-06-2024 (8 Weeks)
Second Mid Term Examinations	17-06-2024 TO 22-06-2024 (1 Week)
Preparation & Practical Examinations	24-06-2024 TO 29-06-2024 (1 Week)
End Semester Examinations	01-07-2024 TO 13-07-2024 (2 Weeks)
Commencement of III B.Tech-I Sem Class work	22-07-2024

PRINCIPAL

1/6/23

PRINCIPAL
G.Narayanamma Institute of
Technology & Science (for woman)
(AUTONOMOUS)
Shaikpet, Hyderabad - 500 104.

G NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE
AUTONOMOUS (FOR WOMEN)
DEPARTMENT OF ELECTRONICS AND TELEMATICS ENGINEERING

Program Outcomes (PO's)– B.Tech. (ETM)

PO-1 Ability to apply the knowledge of mathematics, science, electronics and communication to conceptualize solutions to complex engineering problems.
PO-2 Ability to Identify, formulate and analyze in Engineering domains using first principles of basic sciences and engineering sciences.
PO-3 Ability to design and realize solutions for complex engineering problems with applicable considerations.
PO-4 Ability to support investigations of Research based knowledge including literature survey, design of experiments, data analysis and data interpretation leading to valid conclusions.
PO-5 Ability to choose modern Engineering tools and resources for Electronics & communication engineering problems and their applications
PO-6 Ability to identify and assess societal, safety and legal issues using contextual knowledge and develop potential to assume consequent responsibilities during engineering practice.
PO-7 Ability to recognize the impact of electronics and telematics engineering domain in societal and environmental contexts and demonstrate knowledge and need for sustainable development.
PO-8 Ability to apply ethical principles and practice professional ethics.
PO-9 Ability to function effectively either as an individual or as a member/leader within diversified and multidisciplinary teams.
PO-10 Ability to communicate on engineering activities understandably, among stake holders and society at large through effective reports, design documentation and effective presentations.
PO-11 Ability to demonstrate the knowledge of engineering and apply project management principles to manage projects in multidisciplinary environments as a member and leader in a team.
PO-12 Ability to identify and engage in self-learning in the context of technological changes.

Program Specific Objectives (PSO's)

PSO1 Graduates will be able to analyze and design telecommunication networks with applicable consideration.

PSO2 Graduates will gain technical knowledge with necessary aptitude and soft skills to work in the ICT industry.

GNITS	GNITS/ETE/CPM/22/00
CO-PO Mapping	Department: ETE

II/ IV B. Tech I Semester

GN-R-22

Sub: Drafting the course outcomes for the course **ELECTRONICS DEVICES CIRCUITS**, 2/4 ETE 1ST Sem

Course Outcomes: After completion of the course student must be able to:

CO1	Define and narrate the basic features of different semiconductor diodes, rectifiers, BJTs and FETs
CO2	Explain the construction, operation and characteristics of PN junction diode, Zener diode, BJT, JFET and MOSFET and to outline the transistor biasing circuits
CO3	Apply small signal low frequency model for BJT and develop CE, CB and CC configurations using h-parameters
CO4	Analyze low frequency response of BJT and FET amplifiers with suitable biasing and facilitate comparison of BJT and FET models
CO5	Differentiate between different types of feedback amplifiers and deduce the effects of feedback on Amplifier Characteristics
CO6	To distinguish between amplifiers and Oscillators, discuss and design different RC and LC oscillators and verify their performance characteristics

Mapping of Course Outcomes with Program Outcomes:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	2	-	-	-	-	-	2	1	2	2	2
CO2	3	3	2	3	-	-	-	-	-	2	1	2	2	2
CO3	3	3	2	3	-	-	-	-	-	2	1	2	2	2
CO4	3	3	2	3	-	-	-	-	-	2	1	2	2	2
CO5	3	3	2	3	-	-	-	-	-	2	1	2	2	2
CO6	3	3	2	3	-	-	-	-	-	2	1	2	2	2
CO	**3**	**3**	**2**	**3**	-	-	-	-	-	**2**	**1**	**2**	**2**	**2**

Course Coordinator | Module Coordinator | Program Coordinator

II Year B.Tech. ETE I-Semester
Course Code: 123AR

L	T	P	C
3	1	0	4

ELECTRONIC DEVICES AND CIRCUITS

(Common to ECE, ETE)

Prerequisites: Physics

Course Objectives:

1. To review the basic concepts of semiconductor devices.
2. To explore the construction, operation and characteristics of various electronic devices like diodes and transistors (BJTs and FETs).
3. To Analyze the low frequency response of BJT and FET and to understand different transistor Biasing circuits.
4. To differentiate between various feedback Amplifiers.

UNIT 1: (~10 Lecture Hours)

P-N Junction Diode: Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuits, Load line analysis, Diffusion and Transition Capacitances. Break down Mechanisms-Avalanche breakdown, Zener breakdown, Zener Diode as a Regulator, Tunneling Phenomenon.

Rectifiers: P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor, Full Wave Rectifier, Bridge Rectifier. Rectifiers with Inductive, Capacitive, L and π filters.

UNIT 2: (~10 Lecture Hours)

Bipolar Junction Transistor (BJT): Construction, Principle of Operation, Symbol, Amplifying Action, Common Emitter, Common Base and Common Collector configurations.

Transistor Biasing and Stabilization: Operating point, DC & AC load lines, Biasing - Fixed Bias, Emitter Feedback Bias, Collector to Emitter feedback bias, Voltage divider bias, Bias stability, Stabilization against variations in V_{BE} and β.

UNIT 3: (~8 Lecture Hours)

Small Signal Low Frequency Model of BJT: BJT modelling, Hybrid model (Exact and simplified), Determination of h-parameters from transistor characteristics, Analysis of CE, CB and CC configurations using h-parameters, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors, Comparison of CE, CB and CC configurations.

UNIT 4: (~8 Lecture Hours)

Field Effect Transistors: JFET Construction and Principle of operation, Symbol, Pinch-Off Voltage, Volt-Ampere Characteristic, Small Signal Model, Biasing FET, MOSFET characteristics (Enhancement and depletion mode), Symbols of MOSFET, Comparison of BJT and FET.

UNIT 5: (~9 Lecture Hours)

Positive & Negative Feedback in Amplifiers: Introduction to feedback circuits, Concepts of feedback-Classification of feedback amplifiers - General characteristics of negative feedback amplifiers-Effect of Feedback stability, Stabilization against variations in V_{BE} and β, Bias Compensation using Diodes and Transistors.

Transistor Configurations: BJT modeling, Hybrid model, Determination of h-parameters from transistor characteristics, Analysis of CE, CB and CC configurations using h-parameters, Comparison of CE, CB and CC configurations.

UNIT- V

Junction Field Effect Transistor: Construction, Principle of Operation, Symbol, Pinch-Off Voltage, Volt-Ampere Characteristic, Comparison of BJT and FET, Small Signal Model, Biasing FET.

Special Purpose Devices: Breakdown Mechanisms in Semi-Conductor Diodes, Zener diode characteristics, Use of Zener diode as simple regulator, Principle of operation and Characteristics of Tunnel Diode (With help of Energy band diagram) and Varactor Diode, Principle of Operation of SCR.

Text books:

1) Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2) Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath Mc Graw Hill Education

References:

1) Electronic Devices and Circuits – R.L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2) Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabratajit, TMH, 2/e, 1998.
3) Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, Mc Graw Hill Company, 6th edition.
4) Linear circuit analysis (time domain phasor and Laplace transform approaches)- 2nd edition by Raymond A. DeCarlo and Pen-Min-Lin, Oxford University Press-2004.
5) Network Theory by N. C. Jagan and C. Lakshminarayana, B.S. Publications.
6) Network Theory by Sudhakar, Shyam Mohan Palli, TMH.

Mrs M. Smitha

Name	Dr.T.Sunitha
Mid	1
Subject	EDC
Academic year: 23-24 Sem-1	

Q.No	1a	1b	1c	1d	1e	1f	1g	1h	1i	1j	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b	7a	7b	A1	A2	A3	CO1	CO2	CO3	CO4	CO5	CO6
CO	CO1	CO1	CO2	CO2	CO2	CO1	CO1	CO2	CO1	CO3	CO2	CO1	CO2	CO2	CO2	CO2	CO2	CO3	CO3	CO3	CO1	CO2	CO1	CO2	CO3	11	25.00	9.00	0	0	0
Marks	1	1	1	1	1	1	1	1	1	1	3	2	3	2	2	3	3	2	3	2	3	2	1	3	1						
Roll no																															
22251A1701	0	0	1	1	0.5	1	0	1	0	0	2.5	0	2.5	0	2	0.5					3	1	1	3	1	45.45	60.00	11.11	0	0	0
22251A1702	0	0	1	1	0	1	1	1	1	1	3	0	1.5	0	1.5	3					3	0.5	1	3	1	63.64	62.00	22.22	0	0	0
22251A1703	1	0	1				1	0			2	1	2								2.5		1	3	1	59.09	32.00	11.11	0	0	0
22251A1704	0	0	1	1	0	1	1	0	0	1	2.5	0	3		2	1.5					3	2	1	3	1	54.55	64.00	22.22	0	0	0
22251A1705	0	0	1			0	1		0	1			2		1.5	0				0.5	2		1	3	1	36.36	30.00	27.78	0	0	0
22251A1706	0	0	1	1	1	1	1	1	0	1	3	0	2	0.5	1.5	3					3	0.5	1	3	1	54.55	70.00	22.22	0	0	0
22251A1707	1	0	1	1		0	1	0	0	0	3	2	1.5	0	1.5	0		0			3	0.5	1	3	1	72.73	46.00	11.11	0	0	0
22251A1708	0	0	0	0	0	0.5	0	0	1	1	3	1.5	2		1	3				0.5	1		1	3	1	45.45	48.00	27.78	0	0	0
22251A1709	1	0	1			1	0	0		1	1	0	2		1.5	1				0.5	3		1	3	1	54.55	38.00	27.78	0	0	0
22251A1710	1	0	1		0	0	0		0	1	3	1	2						0.5	0.5	2.5	0	1	3	1	50.00	36.00	33.33	0	0	0
22251A1711	0	0	1	1	0	1	1	1	1	0	3	2			2	3	3	0.5			3	2	1	3	1	81.82	76.00	16.67	0	0	0
22251A1712	0	0.5	1	1	1	1	1	0	1	0	3	1.5			2	3	3	2			2	0	1	3	1	72.73	68.00	33.33	0	0	0
22251A1713	0	0	1	0	0	0	0	0	0	0		0	1	0	2	0			0	0	1		1	3	1	18.18	28.00	11.11	0	0	0
22251A1714	1	1	1	1	0	1	1	0	1	1	3	1.5			2	3	3	1.5	3	0.5			1	3	1	68.18	64.00	77.78	0	0	0
22251A1715	0	0	1	0.5	0	0	0		1	0	2	1	1		2						2.5	0.5	1	3	1	50.00	40.00	11.11	0	0	0
22251A1716	0	0	0	0	0	1	1	0	1	0	2	0.5	0.5		2	3					1	0.5	1	3	1	50.00	44.00	11.11	0	0	0
22251A1717	0	0	1	1	0	0	1	0	0.5	0	2.5	2	2.5			0		0.5				1.5	1	3	1	40.91	46.00	16.67	0	0	0
22251A1718	0	0	1	1	0	1	1	0	0	0.5	2.5	0.5	2		2	0					3		1	3	1	59.09	46.00	16.67	0	0	0
22251A1719	0	0	0	0	0	0	1				0.5	1	1		2	0.5					1		1	3	1	36.36	28.00	11.11	0	0	0
22251A1720	0	0	0	0	1	1	0	0	0		0.5	0	2	0	1.5	0.5			0.5		2.5	0.5	1	3	1	40.91	36.00	16.67	0	0	0
22251A1721	0	0	1	1	1	1	0	1	0	1	2	0.5			2	0	2.5	1	2.5	0.5	2.5	2	1	3	1	45.45	62.00	66.67	0	0	0
22251A1722	0	0	1	1		0	1		1	1		2	2		2	1					2.5	0.5	1	3	1	68.18	42.00	22.22	0	0	0
22251A1724	1	0	0			0	1		1			2	1.5		2	3					2.5		1	3	1	77.27	38.00	11.11	0	0	0
22251A1725	0	0	1	1	0	0	1	0	1	0	2	1.5	2.5	0	2	3					2.5	1.5	1	3	1	63.64	64.00	11.11	0	0	0
22251A1726	1	0	1		0	1	1	0		1			2.5		2	1.5	3			0.5	3		1	3	1	63.64	52.00	27.78	0	0	0
22251A1727	1	0	1	0	1	1	0	0	0	0	3	1.5			2	1	3	0.5			3		1	3	1	68.18	56.00	16.67	0	0	0
22251A1728	0	0	1		0	1	1			0	3	2	3	0	2	3					2.5		1	3	1	68.18	60.00	11.11	0	0	0
22251A1729	0		1	0		1	1		0	0	3	1	2		2	1.5					2		1	3	1	54.55	50.00	11.11	0	0	0
22251A1730	0	0	0	0	0	0	1	0	0	1	3	1.5	1.5		1	1			2.5	0.5	2.5	0.5	1	3	1	54.55	40.00	55.56	0	0	0
22251A1731	1	0	1	0	1	1	1	0	0	0	3	2			2	3	2.5	0			3		1	3	1	81.82	62.00	11.11	0	0	0
22251A1732	0	0	1	0	0	1	1		1	0	3	1			2	2			2.5	0.5			1	3	1	45.45	44.00	44.44	0	0	0
22251A1733	0	0	1	0	0	0	1	0	0		3	0	1.5		1					0.5	2		1	3	1	36.36	38.00	16.67	0	0	0
22251A1734	0	0	1	0	1	1	1	0	0	0	2.5	2	0.5		0.5	2.5					2		1	3	1	63.64	44.00	11.11	0	0	0
22251A1735			1	1	0	1	1	0	0	0	0.5	1	2.5		2	3	0	0			1.5	0.5	1	3	1	50.00	54.00	11.11	0	0	0
22251A1736			1				1		1	1	3	0.5	3						0.5	0.5	3		1	3	1	59.09	40.00	33.33	0	0	0

22251A1737			1			1	1		1	1	2.5	1.5			2	1			1	0.5	2.5	0.5	1	3	1	72.73	40.00	38.89	0	0	0
22251A1738	0	0	1	1	0	0	1	0	1	1	2.5	1.5	1		1	1	3	1			3	1.5	1	3	1	68.18	60.00	33.33	0	0	0
22251A1739			1								1.5		2		1.5						2		1	3	1	27.27	36.00	11.11	0	0	0
22251A1740	0	0	1	0	0	0	0	0	0	1	1.5	0.5	1	0	1	0					0.5	1.5	1	3	1	18.18	36.00	22.22	0	0	0
22251A1741	1	0	1	0	1	0	0	1	0	1	2.5	1	2	0	2	0.5	0.5	0.5			2	0	1	3	1	45.45	54.00	27.78	0	0	0
22251A1742	0	0	1	0	1	1	1		1	1	3	1			2	2	2.5	0.5	0.5		2.5		1	3	1	68.18	58.00	33.33	0	0	0
22251A1743	0	0	1	0	0	1	0	0	0	1	1.5	1.5	2.5	0	1.5	1					2	0	1	3	1	50.00	42.00	22.22	0	0	0
22251A1744	0	0	1	0	0	1	1	0	0	1	2.5	0	1.5		2	1					2.5	0	1	3	1	50.00	44.00	22.22	0	0	0
22251A1745	1	1	1	0	1	1	0	1			2				1.5	3	2	0.5			3		1	3	1	63.64	58.00	16.67	0	0	0
22251A1746	0	1	1	0	0	1	0	0	0	0	1.5	2	2	0	1.5	1					3	0	1	3	1	72.73	40.00	11.11	0	0	0
22251A1747			1			1	1				2.5	0.5	1.5		0.5	2.5	1	0		0.5	3		1	3	1	59.09	48.00	16.67	0	0	0
22251A1748			1	1		1	1	1	1		2.5	0.5			1.5	3	2	0.5			3	1	1	3	1	68.18	64.00	16.67	0	0	0
22251A1749				1		1					2.5	0.5	2				1	0.5			2.5	1.5	1	3	1	45.45	44.00	16.67	0	0	0
22251A1750	1	0	1	1	0	1	1			1	3	2	2.5		2	3					3	1.5	1	3	1	81.82	68.00	22.22	0	0	0
22251A1751	1		1			1	1		1	1	1.5	2	2.5	0	1.5	1			0.5	0.5	3	0.5	1	3	1	90.91	44.00	33.33	0	0	0
22251A1752			1				1				1.5	1	1.5		1						2		1	3	1	45.45	32.00	11.11	0	0	0
22251A1753			1			1			1		1	0.5	0.5		1.5	3		0.5			3	1.5	1	3	1	59.09	46.00	16.67	0	0	0
22251A1754			1			1					0.5		2.5		1.5	3			0.5	0.5	2		1	3	1	36.36	46.00	22.22	0	0	0
22251A1755			1		1	1			0.5		1.5		2		2	1				0.5	2		1	3	1	40.91	46.00	16.67	0	0	0
22251A1756	1	0.5				1	1		1	1	1.5		1.5		1	1					2		1	3	1	68.18	32.00	22.22	0	0	0
22251A1757	1	1				1	1		1	0.5	2		1		1			0.5			2		1	3	1	72.73	28.00	22.22	0	0	0
22251A1758	1	1				1			1	1	1.5										2		1	3	1	63.64	18.00	22.22	0	0	0
22251A1759	1		1			1	1			1	2.5	0.5	2.5		2	3	3	2				1.5	1	3	1	40.91	74.00	44.44	0	0	0
22251A1760			1			1	1	1			1		0.5		1.5	3	3	0.5			3	0.5	1	3	1	54.55	58.00	16.67	0	0	0
22251A1761	1		1			1	1			1	3		2		2	2					3		1	3	1	63.64	52.00	22.22	0	0	0
22251A1762	1	1	1	1	1	1	1	1		1	2.5	1.5			2	3	3	0.5	2	0.5	2.5		1	3	1	81.82	70.00	55.56	0	0	0
22251A1763	1		1	1		1	1				2.5	1.5	2.5		2	1.5	2.5				3		1	3	1	77.27	64.00	11.11	0	0	0
22251A1764	1	1	1	1			1			1	1.5	1.5	1		1.5					0.5	1.5		1	3	1	63.64	36.00	27.78	0	0	0
23255A1701	1	1		1			1			1	2.5	2	2.5	0.5	1.5						2.5		1	3	1	77.27	44.00	22.22	0	0	0
23255A1702	1		1			1	1		1	1	2.5	2	2.5		2	3			2.5	0.5			1	3	1	63.64	56.00	55.56	0	0	0
23255A1703	1		1	1			1	1			1	1			1.5	2	0.5	0.5			2.5		1	3	1	59.09	44.00	16.67	0	0	0
23255A1704			1			1	1	1	1	1	2.5	1	1		0.5		1	1	3	0.5	2		1	3	1	63.64	40.00	72.22	0	0	0
23255A1705	1	0	0	0		1		0	1	0.5	2.5		2								3		1	3	1	63.64	30.00	16.67	0	0	0
23255A1707	0		0			1		0			3		2	0	2						1		1	3	1	27.27	40.00	11.11	0	0	0
69	56	48	64	44	38	62	61	39	48	51	64	56	55	15	62	54	21	23	15	21	64	31	69	69	69						

Class Strength *	69	69	69	69	69	69	69	69	69	69	207	138	207	138	138	207	207	138	207	138	207	138	69	207	69
Marks	25	9	56	24	13	47	47	12	25	33	143	61	101	1	103	96	45	15	22	10	153	26	69	207	69
% of attainment	36	13	81	34	18	67	68	17	36	47	69	44	49	1	74	46	22	11	11	7	74	19	100	100	100

COURSE OUTCOMES	CO1	CO2	CO3	CO4	CO5	CO6
Avg value in % of each CO	43.03	35.87	17.93	0	0	0
No. of students above Threshold level for each CO	57	60.00	35	0	0	0
% of students above Threshold level for each CO	82.61	86.96	50.72	0	0	0
Attainment level COs wise	3	3	1	0	0	0

Name	Dr T Sunitha
Mid	2
Subject	EDC
Academic year: 23-24 Sem-1	

Q.No	1a	1b	1c	1d	1e	1f	1g	1h	1i	1j	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b	7a	7b	A1	A2	A3	A4	A5		CO1	CO2	CO3	CO4	CO5	CO6
CO	CO1	CO2	CO1	CO3	CO4	CO3	CO5	CO5	CO6	CO6	CO3	CO3	CO2	CO4	CO2	CO3	CO5	CO6	CO5	CO6	CO3	CO4	CO2	CO3	CO4	CO5	CO6		2	8	13	6	9	7
Marks	1	1	1	1	1	1	1	1	1	1	3	2	3	2	3	2	3	2	3	2	3	2	1	1	1	1	1							
Roll no																																		
22251A1701	1	0	1	1	1	1	0.5	1	0	0			3	2	2.5	1.5	1	2			2.5	2	1	1	1	1	1		100	81	54	100	39	43
22251A1702	0	0	1	1	1	0	1	1	0	0			3	2	3	0.5	1	1	1	2		2	1	1	1	1	1		50	88	19	100	56	57
22251A1703	1	0	1	1	1	1	1	0.5	1	1			3	2	3		1	1		0	3	2	1	1	1	1	1		100	88	46	100	39	57
22251A1704	1	0	0	1	0	1	1	1	0	0	3	1	3	2	3	2		1					1	1	1	1	1		50	88	69	50	33	29
22251A1705					1	1	0.5	0.5					3	2	2.5	2	1				1	2	1	1	1	1	1		0	81	38	100	33	14
22251A1706	1	0	1	1	1	1	1	1	1	0			3	2	1					2		1	1	1	1	1	1		100	63	23	83	33	57
22251A1707	1	0	1	1	1	1	1	1	1	1			3	2	3	1.5	1.5	1	0.5	2		1	1	1	1	1	1		100	88	35	83	56	86
22251A1708	0	0	0	1	0	1	1	0	0	0	1.5	1	2	2		0.5				2	0	1.5	1	1	1	1	1		0	38	46	75	22	43
22251A1709	1	1	0.5	1	1			1	1				3	2			0.5	0		2		1	1	1	1	1	1		75	63	15	83	28	57
22251A1710		1				1	1	1					3	2	2		1	0.5	1	1			1	1	1	1	1		0	88	15	50	56	36
22251A1711	0	0	1	1	1	1	1	1	1	1			2	2			3	2.5	1	2	2	2	1	1	1	1	1		50	38	38	100	78	107
22251A1712	1		1	1	1	1	1	1	1	1			3	2	3	2	2	1	2.5	2	2.5	2	1	1	1	1	1		100	88	58	100	83	86
22251A1713		1		1	0.5		1	1					3	2	2		1	1	0.5	2		1	1	1	1	1	1		0	88	15	75	50	57
22251A1714	1	1	1	1	1	1	1	1	1	1			3	2			3	2	2	2	3	2	1	1	1	1	1		100	63	46	100	89	100
22251A1715			1	1		1	1	0.5			1	1	2.5	2	3	0.5	1					2	1	1	1	1	1		50	81	42	83	39	14
22251A1716	1			1				0.5				0.5	2.5		3							2	1	1	1	1	1		50	81	19	50	17	14
22251A1717	1		1	1				0.5		1			2.5	2		2	2			2	2		1	1	1	1	1		100	44	46	50	39	57
22251A1718	1		1	1	1		1	1		1			3	2	3	1			1	2		2	1	1	1	1	1		100	88	23	100	44	57
22251A1719	1	1	1	1			1	1					3				1						1	1	1	1	1		100	63	15	17	44	14
22251A1720	1	1	1	1	1	1	0.5		1	1			3	1	2				0.5	2	1	2	1	1	1	1	1		100	88	31	83	22	71
22251A1721	1	1	1	1	1	1	1	1	1	1			3	2	3	2	3	1	2	2			1	1	1	1	1		100	100	38	67	89	86
22251A1722	1	0	1	1	1	1	1	1	1	1			3	2			1	1	1	2	2.5	2	1	1	1	1	1		100	50	42	100	56	86
22251A1724	1	0	0	0	1	1	1	0	0	1			2	2	3	2.5		1			2	1	1	1	1	1	1		50	75	50	83	22	43
22251A1725	1	0	0	0	0	1	1	1	0	1			3	2	3	1	2	1			1		1	1	1	1	1		50	88	31	50	56	43
22251A1726	1	1	1	1		1	1		1	1	2	1	3	2	3					2		2	1	1	1	1	1		100	100	46	83	22	71
22251A1727	1		1	1	1	1	1		1	0.5	2.5	1.5	3	2						2	1	2	1	1	1	1	1		100	50	62	100	22	64
22251A1728	1	1	1	1	1	1	1	1	1	1			2	2	3	2		2		2			1	1	1	1	1		100	88	38	67	33	100
22251A1729	1	1	1	1	1		1		1	0.5	3	1.5	2	2				1	2	2	1	2	1	1	1	1	1		100	50	58	100	44	79
22251A1730		1				1	1	1		1	2.5	1	3	2	3	2					3	2	1	1	1	1	1		0	100	81	83	33	29
22251A1731	1	1	1	1	1	1	1	1	1	1	1.5	1.5				2			3	2	3	2	1	1	1	1	1		100	25	85	67	67	71
22251A1732		1	0.5	1	1	1	1	1	1	1	1		3	2	3					2	3	2	1	1	1	1	1		25	100	54	100	33	71
22251A1733	1	1	1	1	1	1	1	1	1	1			3	2	3	1.5					1.5	2	1	1	1	1	1		100	100	46	100	33	43
22251A1734	1	1	1	1	1	1	0.5	1	1	1	1	2	3	2						2	2	1	1	1	1	1	1		100	63	62	83	28	71
22251A1735	1		1	1			1						3	2	2.5	2		0.5		2		2	1	1	1	1	1		100	81	31	83	22	50
22251A1736	1	0		0.5		1	1	1					3	2	3	2				2		1.5	1	1	1	1	1		50	88	35	75	33	43
22251A1737	1	1	0.5	1	0	1	1	1	1	0.5			3	2	3	0	3	1	2.5	1.5			1	1	1	1	1		75	100	23	50	94	71
22251A1738	1	1	1	1	1	1	1	1	1	1	2.5	1	2	2	3	2	1	0.5	0.5	2	1.5	2	1	1	1	1	1		100	88	77	100	50	79
22251A1739	0	0	0	1	0	1	0.5	1	1		1	1.5	2.5	2	2.5	0.5						2	1	1	1	1	1		0	75	46	83	28	29
22251A1740	0	1	0	0	0	0	0.5	1	1	0.5			3	2	3	0	2	1			0	2	1	1	1	1	1		0	100	8	83	50	50
22251A1741	0	1	1	1	1	1	1	1	1	0			3	2			3	2	2.5	2	2.5	1	1	1	1	1	1		50	63	42	83	94	86
22251A1742	1	1		1		1		1	1	1	1.5	2	3	2	2	2			1.5	0.5	3	2	1	1	1	1	1		50	88	88	83	39	50

22251A1743	1	0	1	1	0.5	1	1			0.5			3	2	2.5	1					2	0.5	1	1	1	1	1
22251A1744	1			1	1		0.5			1			3	2		2				2		2	1	1	1	1	1
22251A1745	0	1	1	1	1	1	0.5	1					3	2	2.5	1				2	2	2	1	1	1	1	1
22251A1746	1	1	1	1	0	1	0	1	0	0			3	2	2.5	1	2.5	2	1	2			1	1	1	1	1
22251A1747	1		1	1	1	1	1	1	1	1			1.5	2	3		0.5	2		2		2	1	1	1	1	1
22251A1748	1	1	0	1	1	1	1	1	1	1			3	2	3	1	2.5	1	1.5	2			1	1	1	1	1
22251A1749	1	0	0	1	0	0	..5	0.5					3	2	2		1.5	1	2				1	1	1	1	1
22251A1750	1	1	1	1	1	1	1	1	1	1			3	2	3	2	1	2		2			1	1	1	1	1
22251A1751	1	1	1	1	1	1	1	1	1	1			3	2	3	1	1	2	2	2			1	1	1	1	1
22251A1752	0.5	1					1	0.5	1	1			1.5	2	2		0.5	0.5	0.5	2			1	1	1	1	1
22251A1753	1	0	0	1	0	0	0.5	0	0	1			3	0.5	2	0.5	1	1		2		1	1	1	1	1	1
22251A1754		1		0.5				1	0	1			2.5	2	2		2	1			1.5	1	1	1	1	1	1
22251A1755		1	1	1			0.5	1	1		1.5	1	2.5	2		1.5		1		1.5		1.5	1	1	1	1	1
22251A1756	1	1	1	1	1	1	0.5	1	1	1			2.5		2				2	2	1.5	2	1	1	1	1	1
22251A1757	1	1					1		1				2.5	2	2.5	0	1	0.5	1.5	2	2	2	1	1	1	1	1
22251A1758	1	1	1	0.5		1	1	1	1	0.5			2						1.5	2		1	1	1	1	1	1
22251A1759	1	1	1	1	1	1	1	1	1	1			3	2	2.5	2	3	1	1	2	2	2	1	1	1	1	1
22251A1760	1	1	1	1	1	1	1	1	0.5	1			3	2			1.5	1.5	2.5	2		2	1	1	1	1	1
22251A1761	1	1	1	1	1	1	1	1	1	1			3	2	3	1			2.5	2		2	1	1	1	1	1
22251A1762	1	1	1	0.5	1	1	0.5	1	1	1	1.5	1	3	2	2.5				2	2	2	2	1	1	1	1	1
22251A1763	1	1		1	1	1	0.5	1	1	1	2	2	3	2			1		2.5	1	2.5	2	1	1	1	1	1
22251A1764	1	1	1	1	1	1	1	1	0.5	1			3	2	3	2	1	1			2.5	2	1	1	1	1	1
23255A1701	1	1	1	1	1	1	1	1	1	1			3	2	3	2	1	1	0.5		2.5	2	1	1	1	1	1
23255A1702	1	1		1	1	1	1	1	1	1			3	2			1	1	1.5	2	0.5	2	1	1	1	1	1
23255A1703			0.5	1			1	1	0.5	1	2	2	3	2					1		1	2	1	1	1	1	1
23255A1704	1	1	1	1	1	1	1	1	1	1			3	0.5			0.5	2	0.5	2		1	1	1	1	1	1
23255A1705	1	1	1	1	1	1	1	1	1	1			3				1	2	1.5	2	0.5	2	1	1	1	1	1
23255A1707	1	1	1	1	0	0	1	0	0			0	2							0		0	1	1	1	1	1
69	60	58	56	64	53	55	64	61	54	54	17	18	68	62	47	38	39	40	35	51	36	55	69	69	69	69	69

100	81	46	67	22	21
50	50	31	100	17	57
50	94	46	100	28	43
100	94	31	50	61	71
100	69	23	100	39	100
50	100	31	67	78	86
50	75	15	50	56	29
100	100	38	67	44	100
100	100	31	67	67	100
25	69	8	50	39	79
50	75	19	42	28	71
0	81	23	67	44	43
50	56	46	75	28	64
100	81	35	67	50	71
50	88	23	83	50	64
100	50	19	33	50	64
100	94	54	100	78	86
100	63	23	100	78	86
100	100	31	100	61	71
100	94	54	100	50	71
50	63	73	100	67	57
100	100	58	100	44	50
100	100	58	100	50	57
50	63	27	100	61	86
25	50	54	83	44	36
100	63	23	58	44	100
100	63	27	67	61	100
100	50	15	17	22	14

Class Strength *	69	69	69	69	69	69	69	69	69	69	207	138	207	138	207	138	207	138	207	138	207	138	69	69	69	69	69
Marks Scored (B)	53	42	45	59	42	50	56	54	43	44	31	23	189	120	125	53	59	49	53	94	67	94	69	69	69	69	69
% of attainment (Question wise)	76	61	65	86	61	72	80	78	62	64	15	16	91	87	60	38	28	35	25	68	32	68	100	100	100	100	100

COURSE OUTCOMES	CO1	CO2	CO3	CO4	CO5	CO6
Avg value in % of each CO	53	58	29	59	35	46
No. of students above Threshold level for each CO	39	57	47	55	45	49
% of students above Threshold level for each CO	57	83	68	80	65	71
Attainment level COs wise	1	3	2	3	2	3

EDC	MID1
COS	Attainment %
CO1	82.61
CO2	86.96
CO3	50.72
CO4	0.00
CO5	0.00
CO6	0.00
Overall Attainment %	73.43
Attainment Level	3

EDC	MID2
COS	Attainment%
CO1	57
CO2	83
CO3	68
CO4	80
CO5	65
CO6	71
Overall Attainment %	71
Attainment Level	3

EDC(MID1& MID2)	INTERNAL
COS	Attainment %
CO1	69.6
CO2	84.8
CO3	59.4
CO4	79.7
CO5	65.2
CO6	71.0
Overall Attainment %	70.3
Attainment Level	3

Range	level
>=70	3
60 to 69	2
50 to 59	1
<50	0

S.No	Roll No	CO1	CO2	CO3	CO4	CO5	CO6
1	22251A1701	2	2	3	2	2	2
2	22251A1702	2	2	2	2	2	3
3	22251A1703	3	3	3	3	3	2
4	22251A1704	3	3	3	2	3	1
5	22251A1705	3	2	3	2	2	2
6	22251A1706	2	2	2	3	2	2
7	22251A1707	3	3	3	2	3	3
8	22251A1708	3	3	2	2	3	2
9	22251A1709	3	3	3	2	3	2
10	22251A1710	2	2	3	1	2	1
11	22251A1711	2	2	3	3	2	3
12	22251A1712	2	3	2	2	3	
13	22251A1713	2	2	3	2	2	3
14	22251A1714	3	2	3	3	2	2
15	22251A1715	3	2	2	2	2	3
16	22251A1716	2	2	2	2	2	1
17	22251A1717	3	3	1	2	3	2
18	22251A1718	2	2	2	2	2	2
19	22251A1719	3	3	3	3	3	3
20	22251A1720	2	3	3	2	3	3
21	22251A1721	2	2	2	3	2	
22	22251A1722	2	2	2	1	2	1
23	22251A1724	2	2	3	2	2	2
24	22251A1725	2	3	2	2	3	1
25	22251A1726	2	2	3	2	2	2
26	22251A1727	2	2	2	2	2	3
27	22251A1728	3	3	3		3	2
28	22251A1729	3	2	2	2	2	2
29	22251A1730	2	2	3	2	3	2
30	22251A1731	2	2	3	2	2	2
31	22251A1732	2	2	3	3	2	3
32	22251A1733	3	2	2	2	3	2
33	22251A1734	3	2	3	2	2	2
34	22251A1735	3	2	3	3	2	1
35	22251A1736	2	3	2	2	3	2
36	22251A1737	2	2	2	3	2	1
37	22251A1738	2	3	3	2	2	3
38	22251A1739	3	2	3	2	2	2
39	22251A1740	2	3	2	3	2	2
40	22251A1741	2	2	3	2	2	3
41	22251A1742	3	2	3	2	2	2
42	22251A1743	2	2	2	2	2	2
43	22251A1744	2	2	3	2	2	2
44	22251A1745	2	2	3	1	2	3
45	22251A1746	2	2	2	2	3	1

46	22251A1747	3	2	2	2	2	3
47	22251A1748	2	2	2	1	1	3
48	22251A1749	3	2	3	2	2	2
49	22251A1750	2	2	3	2	2	2
50	22251A1751	3	2	3	2	2	1
51	22251A1752	3	2	3	3	2	3
52	22251A1753	2	3	2	2	3	2
53	22251A1754	2	2	2	3	2	2
54	22251A1755	2	3	3	2	2	2
55	22251A1756	3	2	3	2	2	3
56	22251A1757	2	3	2	3	2	2
57	22251A1758	2	2	3	2	2	3
58	22251A1759	3	2	3	2	2	2
59	22251A1760	2	2	2	2	2	1
60	22251A1761	2	2	3	2	2	2
61	22251A1762	2	2	3	1	2	3
62	22251A1763	2	2	2	2	3	1
63	22251A1764	3	2	2	2	2	3
64	23255A1701	2	2	2	1	1	3
65	23255A1702	3	2	3	2	2	2
66	23255A1703	2	2	3	2	2	2
67	23255A1704	3	2	3	2	2	3
68	23255A1705	3	2	3	3	2	1
69	23255A1707	2	3	2	2	3	2
Sum of CO levels given by all students		165	156	177	144	154	143
No. of students attempted		68	68	68	67	68	66
Average of each CO		2.43	2.29	2.60	2.15	2.26	2.17

GNITS	
TIME TABLE SEMESTER	ETM/CTW/ 041
	DEPARTMENT : ETE

Academic Year: 2023 – 2024

Branch: ETE **Year: II B.Tech** **Semester - I** **Class Room: F11** **Time Table w.e.f: 11-09-2023**

TIME/ DAY	1 9:00-10:00	2 10:00-11:00	11:00-11:10	3 11:10-12:10	12:10-12:50	4 12:50 -01:50	5 01:50 -02:50	6 02:50 -03:50
MON	NTA	COI	Break	SFCVT	L	BS Lab(G1)/PP Lab(G2)/EDC Lab(G3)		
TUE	PP	EDC		EDC	U	SS	SS	Library/Sports
WED	Placement Training				N	BS Lab(G2)/PP Lab(G3)/EDC Lab(G1)		
THU	BS Lab(G3)/PP Lab(G1)/EDC Lab(G2)				C	PP	NTA	COI
FRI	SFCVT	SFCVT	Break	SS	H	EDC	NTA	Library/Sports
SAT	SS	EDC		NTA		SPDC/MBC/VAC		

Batches: **G1: 22251A1701-1722, 1724-1725** **G2: 22251A1726-1748** **G3: 22251A1749-1764, 23255A1701-1707**

Subject	Name of the Faculty	Subject/Lab	Name of the Faculty
Special Functions and Complex Variable Theory (SFCVT) 123AX	Dr.M.Naga Sree	Basic Simulation Lab (BS-L) 12311	Dr.M.Vijaya Lakshmi/Ms.K.Pranathi
Python Programming (PP) 123AV	Mr.N.Rama Krishna	Python Programming Lab (PP-L) 12317	Mr.N.Rama Krishna/Mrs.V.Anitha
Electronic Devices and Circuits (EDC) 123AR	Dr.T.Sunitha	Electronic Devices and Circuits Lab (EDC-L) 12315	Dr.T.Sunitha/Mrs.A.Rajitha
Signals and Systems (SS) 123AW	Dr.M.Vijaya Lakshmi	Constitution of India (CoI) 12312	Dr.T.Anuradha
Network Theory & Analysis (NTA) 123AT	Mrs.V.Anitha	Skill & Personality Development Centre (SPDC)	Dr. B.Sushma
Value Added Course (VAC)	Mr.A.Chandra Shaker	Mathematics Bridge Course (MBC)	Mrs.N.Gayathri

Class Teacher : **Mrs.V.Anitha**

Dept. Timetable Coordinator **TIME TABLE COORDINATOR** **HOD** **PRINCIPAL**

Copy to: Individual Staff/HOD/Central Time Table Coordinator/Principal/OC/Notice Board

G. Narayanamma Institute of Technology & Science

(Autonomous) *(for Women)*

Shaikpet, Hyderabad- 500 104

II-B.Tech I-Semester *Regular Examinations, Jan/Feb* - 2024

ELECTRONIC DEVICES AND CIRCUITS

(*Common to ECE & ETE*)

Max. Marks: 60 **Time: 03 Hours**

Note:

1. Question paper comprises of **Part A** and **Part B.**
2. **Part A** is compulsory which carries 10 marks. Answer all questions in Part A.
3. **Part B** (for 50 marks) consists of **five questions** with **"either" "or"** pattern. Each question carries 10 marks and may have a,b,c as sub questions. The student has to answer any one full question.

PART-A

(Answer 10 questions. Each question carries 1 mark)

Q.No.	Question	Marks	CO	B L
Q.1	a) Explain different break down mechanisms in a zener diode.	[01]	CO2	[L2]
	b) What is Tunneling effect and give any two applications of a Tunnel diode?	[01]	CO1	[L1]
	c) A transistor has I_B = 50μA and α = 0.99, find β and I_C.	[01]	CO2	[L3]
	d) What is the need of biasing in a transistor circuit?	[01]	CO2	[L2]
	e) What are the effects of bypass and coupling capacitors in a BJT Amplifier?	[01]	CO4	[L2]
	f) Define the following parameters w.r.t. CE configuration. (i) h_{ie} (ii) h_{fe} (iii) h_{re} (iv) h_{oe}	[01]	CO3	[L1]
	g) What is a MOSFET? How it is different from the JFET?	[01]	CO2	[L2]
	h) A JFET has I_D = 2.16mA and $V_{GS(off)}$ = -2.5 V. Calculate I_{DSS} at V_{GS}= -1 V.	[01]	CO2	[L3]
	i) Calculate the gain and input impedance of a voltage series feedback amplifier having A= -300, R_i = 1.5KΩ and β= - (1/20)	[01]	CO5	[L3]
	j) Explain the importance of crystal oscillators.	[01]	CO6	[L1]

END OF PART A

PART-B

(Answer 05 full questions. Each question carries ***10 marks****)*

Q.No.	Question	Marks	CO	B [L..
Q.2(a)	A Ge diode carries a current of 15mA when the forward bias voltage is 0.3 V. (i) Estimate the reverse saturation current (ii) Calculate the bias voltages needs for the diode currents of 1mA and 50 mA.	[04]	CO2	[L..
(b)	Explain the working of a FWR with a capacitor filter and derive ripple factor formula.	[06]	CO1	[L3]
	OR			
Q.3(a)	Compare Half wave , Full wave center tapped and Full wave Bridge rectifiers.	[04]	CO1	[L2]
(b)	Explain the working of a Tunnel diode with neat sketches.	[06]	CO1	[L2]
Q.4(a)	Explain transistor input and output characteristics in a common base configuration.	[05]	CO2	[L2]
(b)	Design a voltage divider bias circuit for the following specifications: $V_{cc} = 12V$, $V_{CE}=2$ V, $I_C=4mA$ and $h_{fe}=80$	[05]	CO2	[L5]
	OR			
Q.5(a)	Explain transistor input and output characteristics in a common emitter configuration.	[05]	CO2	[L2]
(b)	Derive the stability factor expression for a BJT with Voltage divider bias.	[05]	CO2	[L3]
Q.6(a)	Explain low frequency response of a BJT amplifier.	[04]	CO4	[L2]
(b)	Analyze A_I ,R_I ,Av, CE configuration using h-parameter model.	[06]	CO3	[L4]
	OR			
Q.7(a)	For the common emitter with $R_S = 0.5K\Omega$ and $R_L = 5K\Omega$, calculate A_I, R_i, Av and R_0. Assume $h_{fe}=50$, $h_{ie}=1K\Omega$, $h_{oe}=25\mu A/V$, $h_{re} =2 \times 10^{-4}$.	[05]	CO3	[L5]
(b)	Compare CE , CB and CC configurations.	[05]	CO4	[L2]
Q.8(a)	Explain N-Channel JFET operation and it's characteristics.	[06]	CO2	[L2]
(b)	Compare JFET and MOSFETs.	[04]	CO2	[L2]
	OR			
Q.9(a)	Explain the operation and V-I Characteristics of a MOSFET in depletion mode.	[05]	CO2	[L2]
(b)	Draw and explain JFET with Self bias arrangement.	[05]	CO2	[L2]
Q.10(a)	Draw the circuit diagram of a voltage series feedback using BJT and derive an expression for the voltage gain, Input impedance and output impedance with feedback.	[05]	CO5	[L4]
(b)	Explain the operation of a Colpitts oscillator and derive frequency of operation expression.	[05]	CO6	[L4]
	OR			
Q.11(a)	Draw the circuit diagram of a current shunt feedback using BJT and derive an expression for the voltage gain, Input impedance and output impedance with feedback.	[05]	CO5	[L4]
(b)	Explain the operation of a Wien bridge Oscillator and derive frequency of operation expression.	[05]	CO6	[L4]

END OF PART B

END OF THE QUESTION PAPER

P-N Junction Diode

Theory of P-N Junction:

P 24/3

Open-Circuited P-n Junction:

(1) • When a P-type semiconductor is suitably joined to N-type semiconductor, the contact surface is called P-N Junction. and it is a fundamental component of many electronic devices.

(or)

• If donor impurities are doped into one side and acceptors into the other side of a single crystal of a semiconductor, a PN-Junction is formed.

(2) • The donor atom "donates" an electron and it becomes donor ion and is represented by '+' sign (becomes positive ion). The acceptor atom "accepts" an electron, it becomes a negative ion and is indicated by '-' sign.

(3) • Initially there are only holes in the P-side and electrons in the N-side. Because of carrier concentration gradient across the junction, holes will diffuse to the right across the junction and electrons to the left.

. This movement of charge carriers produces a current is called "Diffusion current".

(4) · Once the electron cross the junction, in n-side creates a positive ion because of loss of an electron and in the P-type creates a negative ion because of gain of an electron. This process is continuous.

(5)

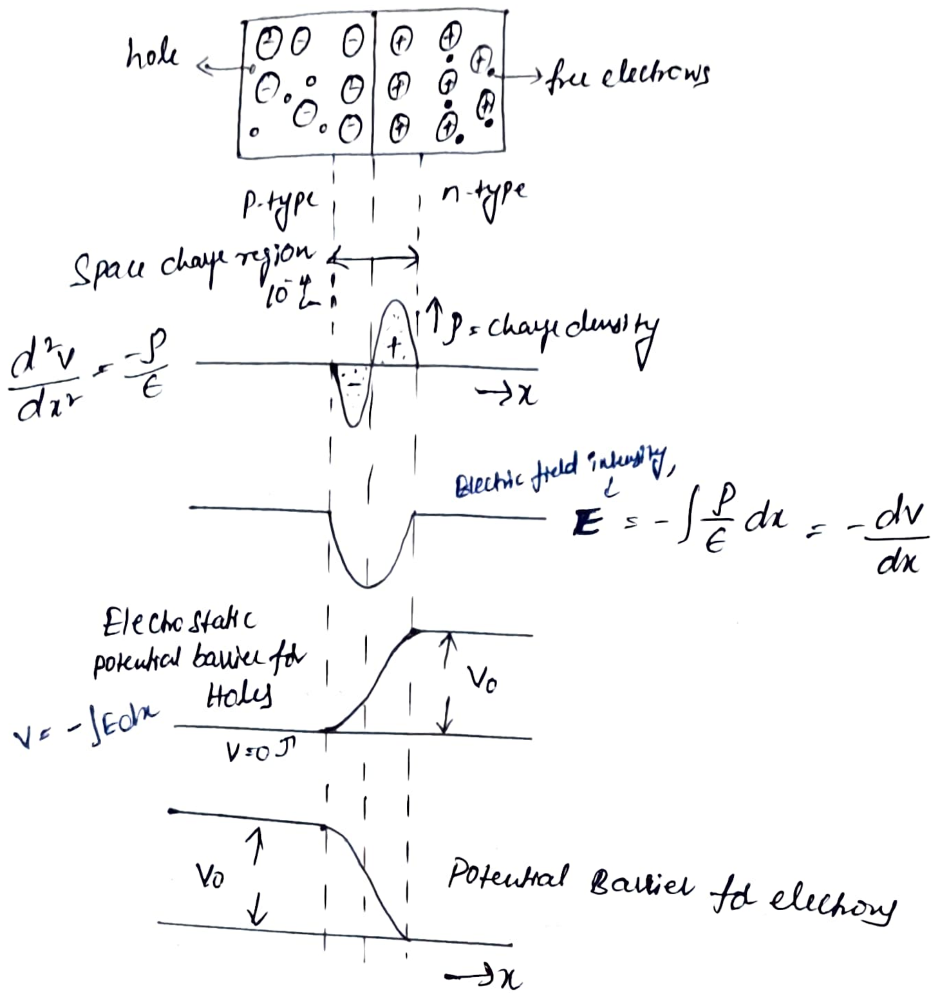


fig: Potential distribution in P-n junction diode

(6) • The positive and -ve charge ions generates Electrostatic field (or) Electric potential across the junction. Equilibrium will be established when the field becomes large.

• " Equilibrium potential is the potential that a sufficient to stop the further diffusion of majority carriers."

(7) • The general shape of the charge distribution in fig.

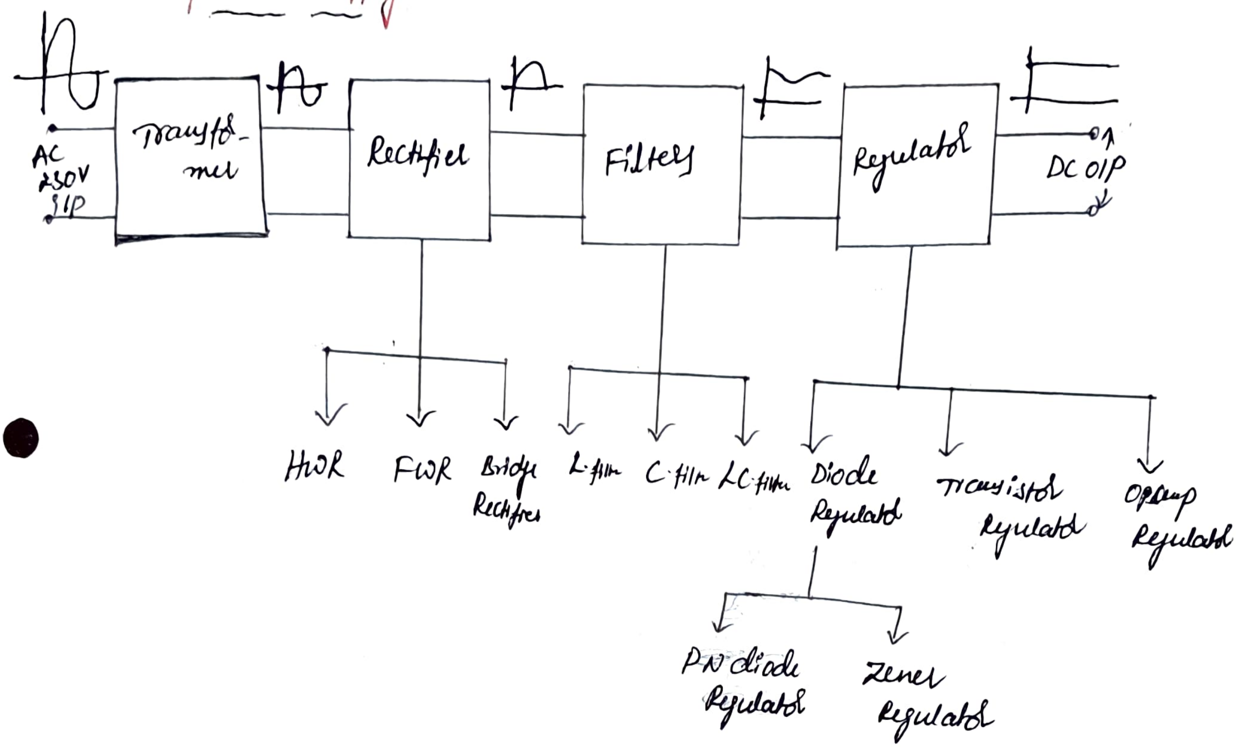
(c) • The region adjacent to the P-N junction which is depleted (become less) of charge carriers is called depletion region (or) transition region (or) space charge region. (Thickness is 10^{-4} cm = 10^{-6} m = 1 micron)

• The width of the depletion region depends upon the doping

UNIT – I

Rectifiers, Filters and Regulators

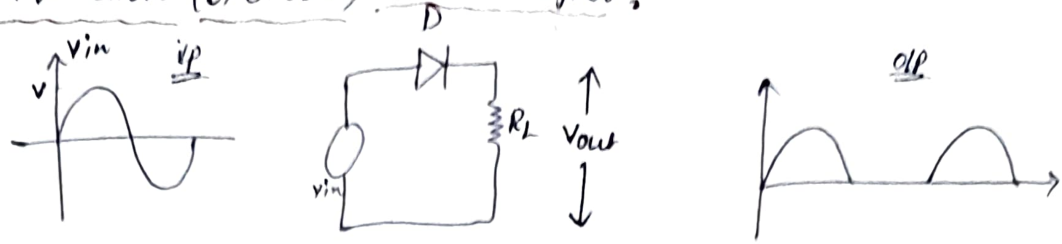
Power supply



Rectifiers:

- The electronic circuits require a D.C source of power. For transistor AC amplifier circuit for biasing dc supply is required. The input signal can be AC and so the output signal will be amplified AC signal. But without biasing with D.C supply, the circuit will not work.
  So more or less all electronic a.c instruments require d.c power. To get this, ~~economical~~ To convert a.c power into d.c.
- Definition of Rectifier: The process of converting an a.c (alternating current) to pulsating d.c is called as Rectifier (or) Rectification.
- Rectifier converts Bidirectional to unidirectional.

• A P-n Junction (or) diode as a Rectifier:



- During the positive cycle of a.c input voltage the diode becomes forward biased and conducts current in to the ckt. The result is that the positive cycle of input voltage appears across 'RL'. ~~during~~
- During the negative half cycle of a.c input voltage the diode becomes reverse biased. The diode does not conduct current and no voltage appear across RL.
- The result is that the output consists of positive half cycles of input ac voltage while the negative half cycles are supressed. Thus the diode converts a.c to pulsating d.c.
- Then the behaviour of diode is like a switch.
- Rectifier converts Bi directional to unidirectional.
- ~~Rect~~ i.e it converts sinusoidal signal to unidirectional flow and not pure d.c
- A Rectifier utilizes unidirectional conduction level like a vaccum diode (or) pn Junction diode.

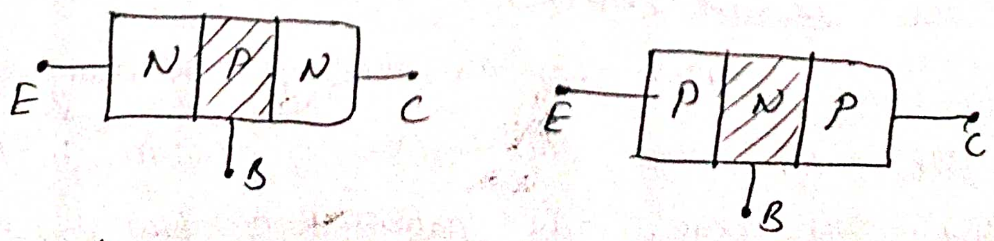
- Rectifiers are classified depending upon the period of conduction as
  - → Half wave Rectifier
  - → Full wave Rectifier
    - → centre-tapped FWR
    - → Bridge FWR

- Generally A.c supply is given through a transformer. The use of transformer permits two advantages. They are,

UNIT-II

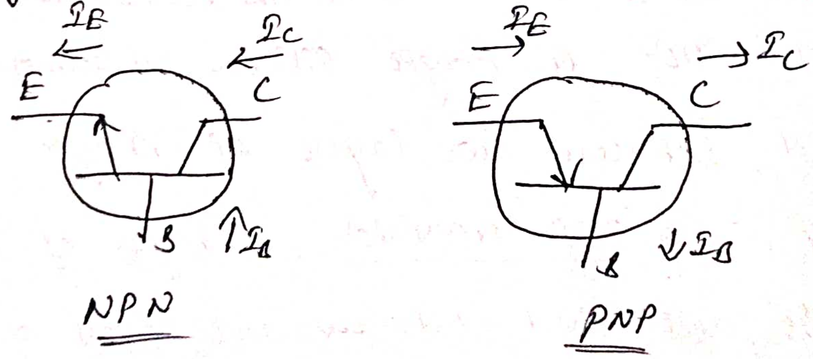
Bipolar Junction Transistor [BJT]

- A Bipolar Junction Transistor (BJT) is a three terminal semiconductor device in which conduction takes place due to two types of carriers, electrons and holes is called and hence a Bi-polar device. the name Bipolar.
- When there is transfer of resistance from input side which is Forward Bias (low resistance) to outside output side which is Reverse Biased (High Resistance), it is a Trans resistor (or) Transistor device.
- There are two types of transistor – NPN – PNP
- The Transistor has 2 Pn Junctions, i.e like 2 diodes. one far' back
- In NPN Transistor, a P-type silicon (or) Germanium is sandwitched between two layers of n-type silicon. Alternatively, in a PNP Transistor, a layer of N-type material is sandwiched between two layers of P-type material.
- Two types of the BJT are represented in below fig. BJT is containing two PN Junctions.



The Three Portions of the transistor are Emitter, Base and collector as shown in above fig shown as E, B, C respectively.

- Emitter is heavily doped so that it can inject a large no. of charge carriers into Base.
- Base is lightly doped and very thin. It passes most of the injected charge carriers from the emitter to collector.
- collector is moderately doped.
- The Emitter is moderately spaced, base is width is very thin and the collector is largely spaced (ie wider than both E, B)
- The transistor operation can only be obtained, if both the PN junctions are biased by connected dc voltages across them.
- The symbols for npn & pnp transistors given below



The arrow on the emitter lead specifies the direction of current flow when the emitter-base junction is biased in the forward direction.

- The emitter of NPN has an arrow pointing away from the base while the arrow case be case of emitter in PNP is pointing into the base. The polarities of bias voltages of NPN are opposite to that of PNP

UNIT-IV II

Transistor Biasing and Stabilization

Introduction

① • The basic function of a transistor is amplification where a weak signal is given to the amplifier and an amplified output is obtained in the collector circuit.

② • An amplifier should amplify the signal i.e increase its strength but should not change the shape.
The increase in size without change in shape is called faithful amplification.

③ • Inorder to achieve this the base emitter junction should be forward biased and output junction (i.e collector to base junction) should be reverse biased during all parts of the signal. This can be achieved by transistor biasing. (or) This is known as Transistor biasing.

→ Operating Point : The point at which the transistor operates is called operating point (or) quiescent point.

• The transistor should be made to operate in active region to amplify. ⑥ To establish the operating point in the active region necessary to provide appropriate direct potentials using external sources. This allows the faithful reproduction of output signal for the variations in input signal. Both of them have the same waveform.

• If the output is not a faithful reproduction of the i/p signal then the operating point must be relocated to obtain on the

Collector Characteristics.

Faithful Amplification:

- The process of raising the strength of a weak signal without any change in its general shape is known as

UNIT-~~V~~ III

Small Signal Low Frequency BJT Models

Introduction :

- The V-I characteristics of an active device such as BJT are non-linear.
- The analysis of a non-linear device is complex. Thus to simplify the analysis of BJT, its operation is restricted to the linear V-I characteristics around the Q-point i.e in the active region. This approximation is possible only with small input signals.
- With small input signals the transistor can be replaced with small signal linear model. This model is also called small signal equivalent circuit.

Small signal analysis of transistor:

- In small signal analysis, we assume that the input a.c signal peak to peak to amplitude is very small around the operating point 'Q'.

The swing of the signal always lies in the active region, and so the output is not distorted.

- In the large signal anlaysis, the swing of the input signal is over a wide range around the operating point. The magnitude of the input signal is very large. Because of this the operating region will extend into the cut-off region and also saturation region.

→ **Small signal Low frequency Transistor amplifier Circuits:**

- An amplifier is used to increase the signal level. i.e the amplifier is used to get a larger signal output from a small signal input.

  Eg: If the input of the amplifier is a sinusoidal signal, then at the output, signal must remain sinusoidal in waveform, with same frequency as that of the input but the magnitude of the o/p is larger than that of the input.

- To make the transistor work as an amplifier, it is to be biased to operate in the active region i.e Base-emitter junction is to be forward biased, while base-collector junction to be reverse biased.

Common Emitter amplifier Circuit:

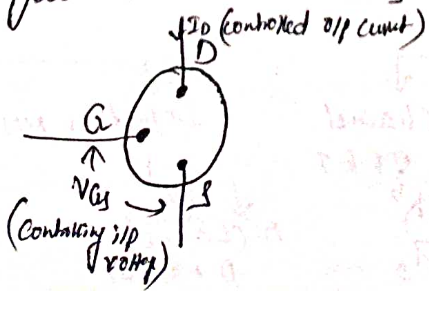
- In the absence of the input signal, only d.c voltage are present in the circuit, is known as zero-signal (or) no-signal condition (or) quiescent condition for the amplifier.
- The d.c collector-emitter voltage, V_{CE}, the d.c collector current I_C and d.c base current I_B is the quiescent operating point for the amplifier.
- On this d.c quiescent operating point, a.c sinusoidal voltage at the input as shown in below fig. Due to this base current varies

UNIT-IV

Field Effect Transistor

Introduction: • FET is an another semiconductor device like BJT.

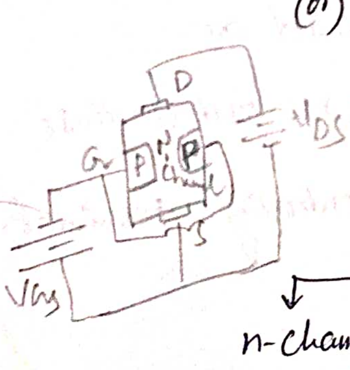
- FET is a Field Effect Transistor and it is a unipolar device because the current through it results from the flow of only one of the two kinds of charge carriers (i.e holes (or) electrons).
- The name "Field Effect" is derived from the fact that the output current flow is controlled by an Electric field setup in the device by an externally applied voltage.
- FET is a voltage controlled device because the o/p voltage current is controlled by applying external voltage.
- FET is also a Three terminal device, however the principle of operation of FET is completely different from that of BJT.
- The Three terminals of FET are named as Drain (D), source (S) and Gate (G). Out of these terminals gate terminal acts as a controlling terminal.



- The main drawbacks of BJT's are
  - → It has low input impedance because of forward biased Emitter Junction
  - → There is considerable noise is present in the transistor.

These drawbacks have been overcome to great extent in the field Effect transistors.

- FET has very high input impedance. Because FETs are more preferable in amplifiers because it has high i/p impedance.
- FET require less space than that for BJT, hence they are preferred in integrated circuits.
- Like BJT, the parameter of FET are also temperature dependent. In FET, as temperature increases drain resistance also increases, reducing the drain current. Thus we can say that FET is more temperature stable as compared to the BJT.
- There are two types of FET's :
  1) Junction field Effect transistor (JFET) (or) simply FET)
  2) Metal oxide semiconductor transistor FET (MOS FET).
     (or) Insulated-gate field effect transistor FET (IGFET).



FET
- JFET
  - n-Channel JFET
  - P-Channel JFET
- MOSFET
  - Depletion MOSFET
    - n-Channel D-MOSFET
    - P-Channel D-MOSFET
  - Enhancement MOSFET
    - n-Channel E-MOSFET
    - P-Channel E-MOSFET

UNIT- 5

FEEDBACK AMPLIFIERS

Introduction :

- An ideal amplifier will provide an stable output which is in an amplified version of the input signal.
- But the gain and stability of practical amplifiers is not very good because of device parameter variation (or) due to changes in ambient Temperature and non linearity of the device.
- This problem can be avoided by the technique of feedback.

Concept of Feedback :

- In the process of feedback, a portion of the output signal is fed back to the input and combined with the input signal to produce the desired output.
- The feedback can be classified into two types :
  - → Negative feedback
  - → Positive feedback

• **Positive feedback :**

- When the feedback signal (part of output signal) is in phase with the input signal and thus aids, it is known as positive feedback (or) Regenerative feedback (or) direct feedback. Because the voltage gain of a feedback is greater than the open loop gain.

- The positive feedback (PFB) increases the gain of the amplifier.
- P.F.B increases in noise, Distortion and poor stability.

• <u>Negative feedback:</u>

- when the feedback signal is out of phase (180°) with the input signal and thus opposes it, it is known as Negative feedback and also known as Degenerative (or) Reverse feedback.
- Negative feedback (N.F.B) decreases the gain of the amplifier.
- N.F.B improves the stability in gain
- It decreases the noise level and distortion.
- Other advantages of negative feedbacks are
  - Higher input and lower output impedance
  - Increased band width
  - Improved gain sensitivity

Dis<u>advantages</u> are,

- Reduced circuit overall gain
- Reduced stability at high frequency

→ Use of positive feedback results in oscillations and hence not used in amplifiers

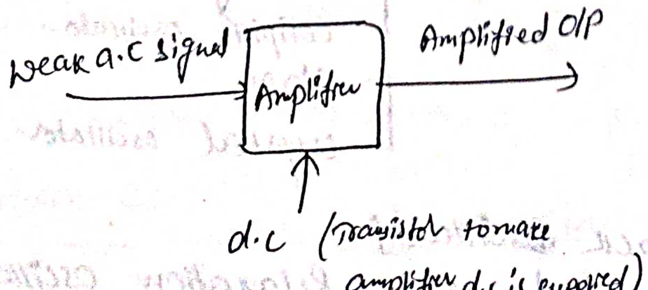
UNIT - IV

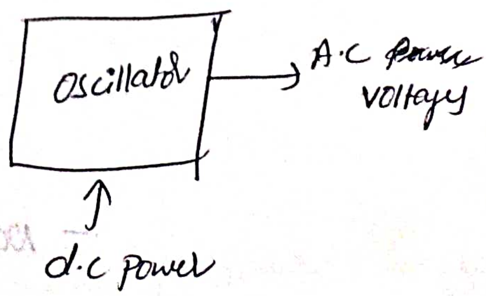
Oscillators

Introduction :

- All electronic communication systems like TV, Radio, computers and industrial instrumentation systems require the different types of waveforms like sinusoidal, Square wave, pulses & triangular wave of specified frequency and amplitude.
- These signals are generated by electronic circuits known as "oscillators" (or) "wave generator". It is basically an amplifier circuit with positive feedback.
- oscillators :

  It is a circuit, which basically acts as a wave generator, generating the output signals like sine, triangular, square etc which oscillates with constant amplitude and constant desired frequency.
- Oscillator is also acts as converter, it converts the powers i.e from dc power supply into ac power.
-





Types of oscillators :

- The oscillators are classified based on nature of the output waveform, the parameters used, the range of frequency etc.
- The various ways in which oscillators are classified as,

1) According to the output waveform ((or) waveform generated):
   - a) Sinusoidal oscillators Ex: Sine wave
   - b) Non sinusoidal oscillators Ex: Relaxation oscillation (triangular, square, sawtooth etc) (Other than sine wave)

2) According to circuit components :
   - RC oscillators
   - LC oscillators
   - Crystal oscillators

3) According to the range of operating frequency:
   - Audio (or) Low frequency oscillators (20Hz – 200KHz)
   - Radio (or) High frequency oscillators (~~200KHz & upto giga hertz (GHz)~~) >20KHz

4) Depending upon feedback used :
   - Feedback type of oscillators
     - RC ~~feedback~~ type oscillator
       - RC Phase shift oscillator
       - Wein Bridge oscillator
     - LC type oscillator
       - LC oscillator
       - Hartely oscillator
       - Colpitts oscillator
       - Clapp
       - Crystal oscillator
   - Non feedback oscillators
     - UJT Relaxation oscillator

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Content Beyond Syllabus/ Case Study	**Department: ETE**

Class: B.Tech II/IV, Sem – I

Subject: Electronic Devices and Circuits

Subject Code: 123AR

Academic Year: 2023-24

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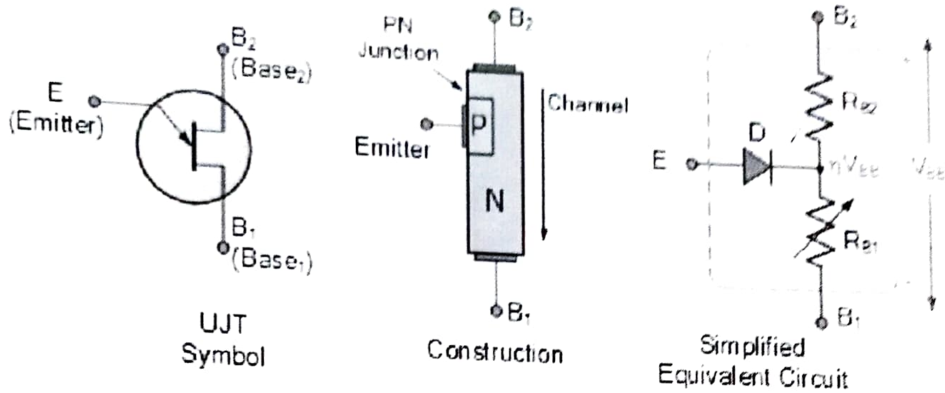
Following are the details of topics to be covered other than syllabus.

S.No	Unit	Topic	Contents	CO
1.	II	Unijunction Transistor	UJT Applications, UJT Relaxation Oscillator, UJT Oscillator Waveforms, UJT Speed Control Circuit	CO2,CO6

Dr. T. Sunitha

Name and Signature of faculty:

HOD, ETE Dept



Unijunction Transistor

The UJT is a three-terminal, semiconductor device which exhibits negative resistance and switching characteristics for use as a relaxation oscillator in phase control applications

The **Unijunction Transistor** or **UJT** for short, is another solid state three terminal device that can be used in gate pulse, timing circuits and trigger generator applications to switch and control either thyristors and triac's for AC power control type applications.

Like diodes, unijunction transistors are constructed from separate P-type and N-type semiconductor materials forming a single (hence its name Uni-Junction) PN-junction within the main conducting N-type channel of the device.

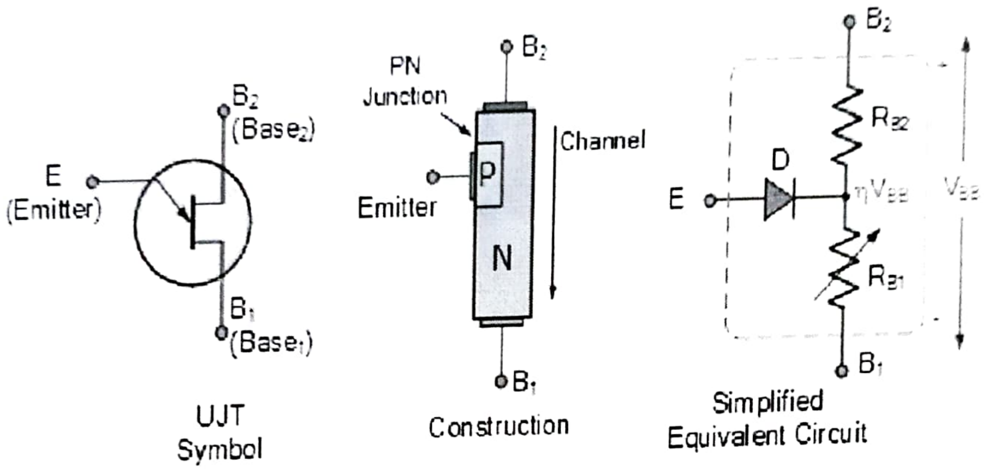
Although the *Unijunction Transistor* has the name of a transistor, its switching characteristics are very different from those of a conventional bipolar or field effect transistor as it can not be used to amplify a signal but instead is used as a ON-OFF switching transistor. UJT's have unidirectional conductivity and negative impedance characteristics acting more like a variable voltage divider during breakdown.

Like N-channel FET's, the UJT consists of a single solid piece of N-type semiconductor material forming the main current carrying channel with its two outer connections marked as *Base 2* (B_2) and *Base 1* (B_1). The third connection, confusingly marked as the *Emitter* (E) is located along the channel. The emitter terminal is represented by an arrow pointing from the P-type emitter to the N-type base.

The Emitter rectifying p-n junction of the unijunction transistor is formed by fusing the P-type material into the N-type silicon channel. However, P-channel UJT's with an N-type Emitter terminal are also available but these are little used.

The Emitter junction is positioned along the channel so that it is closer to terminal B_2 than B_1. An arrow is used in the UJT symbol which points towards the base indicating that the Emitter terminal is positive and the silicon bar is negative material. Below shows the symbol, construction, and equivalent circuit of the UJT.

Unijunction Transistor Symbol and Construction



Notice that the symbol for the unijunction transistor looks very similar to that of the junction field effect transistor or JFET, except that it has a bent arrow representing the Emitter(E) input. While similar in respect of their ohmic channels, JFET's and UJT's operate very differently and should not be confused.

So how does it work? We can see from the equivalent circuit above, that the N-type channel basically consists of two resistors R_{B2} and R_{B1} in series with an equivalent (ideal) diode, D representing the p-n junction connected to their center point. This Emitter p-n junction is fixed in position along the ohmic channel during manufacture and can therefore not be changed.

Resistance R_{B1} is given between the Emitter, E and terminal B_1, while resistance R_{B2} is given between the Emitter, E and terminal B_2. As the physical position of the p-n junction is closer to terminal B_2 than B_1 the resistive value of R_{B2} will be less than R_{B1}.

The total resistance of the silicon bar (its Ohmic resistance) will be dependent upon the semiconductors actual doping level as well as the physical dimensions of the N-type silicon channel but can be represented by R_{BB}. If measured with an ohmmeter, this static resistance would typically measure somewhere between about 4kΩ and 10kΩ's for most common UJT's such as the 2N1671, 2N2646 or the 2N2647.

These two series resistances produce a voltage divider network between the two base terminals of the unijunction transistor and since this channel stretches from B_2 to B_1, when a voltage is applied across the device, the potential at any point along the channel will be in proportion to its position between terminals B_2 and B_1. The level of the voltage gradient therefore depends upon the amount of supply voltage.

When used in a circuit, terminal B_1 is connected to ground and the Emitter serves as the input to the device. Suppose a voltage V_{BB} is applied across the UJT between B_2 and B_1 so that B_2 is biased positive relative to B_1. With zero Emitter input applied, the voltage developed across R_{B1} (the lower resistance) of the resistive voltage divider can be calculated as:

Unijunction Transistor R_{B1} Voltage

$$V_{RB1} = \frac{R_{B1}}{R_{B1} + R_{B2}} \times V_{BB}$$

For a unijunction transistor, the resistive ratio of R_{B1} to R_{BB} shown above is called the **intrinsic stand-off ratio** and is given the Greek symbol: **η** (eta). Typical standard values of η range from 0.5 to 0.8 for most common UJT's

If a small positive input voltage which is less than the voltage developed across resistance, R_{B1} (ηV_{BB}) is now applied to the Emitter input terminal, the diode p-n junction is reverse biased, thus offering a very high impedance and the device does not conduct. The UJT is switched "OFF" and zero current flows.

However, when the Emitter input voltage is increased and becomes greater than V_{RB1} (or ηV_{BB} + 0.7V, where 0.7V equals the p-n junction diode volt drop) the p-n junction becomes forward biased and the unijunction transistor begins to conduct. The result is that Emitter current, ηI_E now flows from the Emitter into the Base region.

$V_{RB1} = \eta V_{BB} + 0.7V)$

The effect of the additional Emitter current flowing into the Base reduces the resistive portion of the channel between the Emitter junction and the B_1 terminal. This reduction in the value of R_{B1} resistance to a very low value means that the Emitter junction becomes even more forward biased resulting in a larger current flow. The effect of this results in a negative resistance at the Emitter terminal.

Likewise, if the input voltage applied between the Emitter and B_1 terminal decreases to a value below breakdown, the resistive value of R_{B1} increases to a high value. Then the **Unijunction Transistor** can be thought of as a voltage breakdown device.

So we can see that the resistance presented by R_{B1} is variable and is dependant on the value of Emitter current, I_E. Then forward biasing the Emitter junction with respect to B_1 causes more current to flow which reduces the resistance between the Emitter, E and B_1.

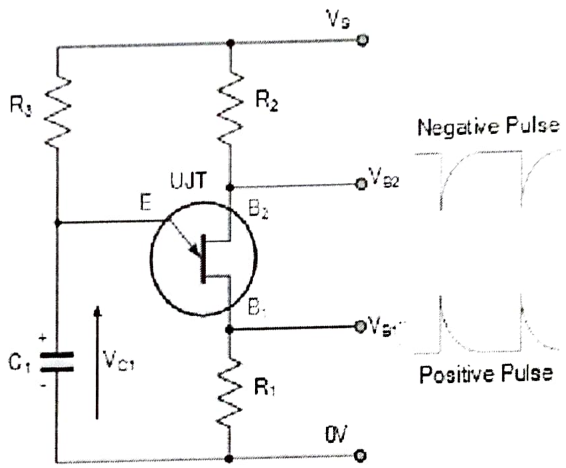
In other words, the flow of current into the UJT's Emitter causes the resistive value of R_{B1} to decrease and the voltage drop across it, V_{RB1} must also decrease, allowing more current to flow producing a negative resistance condition.

Unijunction Transistor Applications

Now that we know how a *unijunction transistor* works, what can they be used for. The most common application of a unijunction transistor is as a triggering device for *SCR's* and *Triacs* but other UJT applications include sawtoothed generators, simple oscillators, phase control, and timing circuits. The simplest of all UJT circuits is the Relaxation Oscillator producing non-sinusoidal waveforms.

In a basic and typical UJT relaxation oscillator circuit, the Emitter terminal of the unijunction transistor is connected to the junction of a series connected resistor and capacitor, RC circuit as shown below.

Unijunction Transistor Relaxation Oscillator

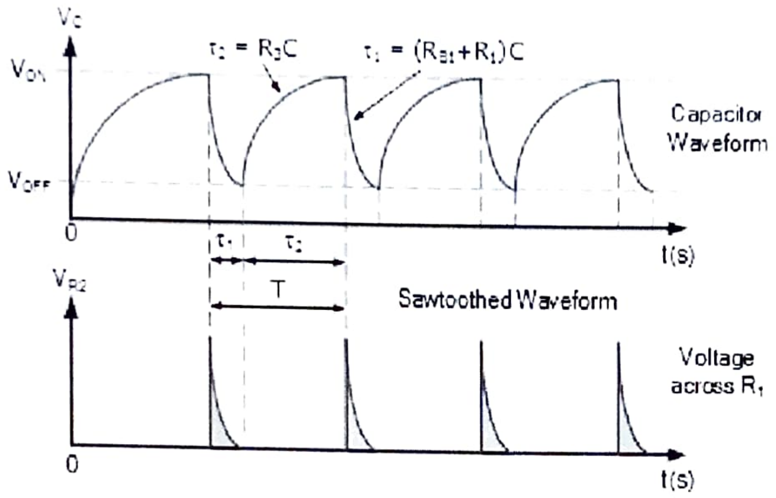


When a voltage (Vs) is firstly applied, the unijunction transistor is "OFF" and the capacitor C1 is fully discharged but begins to charge up exponentially through resistor R3. As the Emitter of the UJT is connected to the capacitor, when the charging voltage Vc across the capacitor becomes greater than the diode volt drop value, the p-n junction behaves as a normal diode and becomes forward biased triggering the UJT into conduction. The unijunction transistor is "ON". At this point the Emitter to B1 impedance collapses as the Emitter goes into a low impedance saturated state with the flow of Emitter current through R1 taking place.

As the ohmic value of resistor R1 is very low, the capacitor discharges rapidly through the UJT and a fast rising voltage pulse appears across R1. Also, because the capacitor discharges more quickly through the UJT than it does charging up through resistor R3, the discharging time is a lot less than the charging time as the capacitor discharges through the low resistance UJT.

...across the capacitor decreases below the holding point of the p-n junction (V_{OFF}), the UJT turns "OFF" and no current flows into the Emitter junction so once again the capacitor charges up through resistor R3 and this charging and discharging process between V_{ON} and V_{OFF} is constantly repeated while there is a supply voltage, Vs applied. 5/6

UJT Oscillator Waveforms



Then we can see that the unijunction oscillator continually switches "ON" and "OFF" without any feedback. The frequency of operation of the oscillator is directly affected by the value of the charging resistance R3, in series with the capacitor C1 and the value of η. The output pulse shape generated from the Base1 (B1) terminal is that of a sawtooth waveform and to regulate the time period, you only have to change the ohmic value of resistance, R3 since it sets the RC time constant for charging the capacitor.

The time period, T of the sawtoothed waveform will be given as the charging time plus the discharging time of the capacitor. As the discharge time, τ_1 is generally very short in comparison to the larger RC charging time, τ_2 the time period of oscillation is more or less equivalent to $T \cong \tau_2$. The frequency of oscillation is therefore given by ƒ = 1/T.

UJT Oscillator Example No1

The data sheet for a 2N2646 Unijunction Transistor gives the intrinsic stand-off ratio η as 0.65. If a 100nF capacitor is used to generate the timing pulses, calculate the timing resistor required to produce an oscillation frequency of 100Hz.

1. The timing period is given as:

$$f = \frac{1}{T}, \quad \therefore T = \frac{1}{f} = \frac{1}{100} = 10\text{mS}$$

2. The value of the timing resistor, R_3 is calculated as:

$$T = R_3 C \ln\left(\frac{1}{1-\eta}\right)$$

$$\therefore R_3 = \frac{T}{C \times \ln\left(\frac{1}{1-\eta}\right)} = \frac{10mS}{100nF \times \ln\left(\frac{1}{1-0.65}\right)}$$

$$\therefore R_3 = 95.238\Omega \text{ or } 95.3k\Omega$$

Then the value of charging resistor required in this simple example is calculated as 95.3kΩ's to the nearest preferred value. However, there are certain conditions required for the UJT relaxation oscillator to operate correctly as the resistive value of R3 can be too large or too small.

For example, if the value of R3 was too large, (Megohms) the capacitor may not charge up sufficiently to trigger the Unijunction's Emitter into conduction but must also be large enough to ensure that the UJT switches "OFF" once the capacitor has discharged to below the lower trigger voltage.

Likewise if the value of R3 was too small, (a few hundred Ohms) once triggered the current flowing into the Emitter terminal may be sufficiently large to drive the device into its saturation region preventing it from turning "OFF" completely. Either way the unijunction oscillator circuit would fail to oscillate.

UJT Speed Control Circuit

One typical application of the unijunction transistor circuit above is to generate a series of pulses to fire and control a thyristor. By using the UJT as a phase control triggering circuit in conjunction with an SCR or Triac, we can adjust the speed of a universal AC or DC motor as shown.

Unijunction Transistor Speed Control