A NAAC Accredited Institution
KINGS
COLLEGE OF ENGINEERING
Recognized under 2(f) & 12(B) of UGC
Approved by AICTE, New Delhi
Affiliated to Anna University, Chennai

1.1.1 CURRICULUM PLANNING AND IMPLEMENTATION

KINGS COLLEGE OF ENGINEERING

Academic Calendar Academic Year 2021-2022 (Odd Semester)

AUGUST 2021

DATE	DAY	Events
02.08.21	Monday	
03.08.21	Tuesday	
04.08.21	Wednesday	Staff Council Meeting
05.08.21	Thursday	
06.08.21	Friday	
07.08.21	Saturday	**Holiday**
09.08.21	Monday	
10.08.21	Tuesday	Submission of DRM Minutes by HODs to IQAC Coordinator
11.08.21	Wednesday	
12.08.21	Thursday	
13.08.21	Friday	
14.08.21	Saturday	
16.08.21	Monday	Submission of DRC Meeting Minutes by DRC Convener to Principal
17.08.21	Tuesday	
18.08.21	Wednesday	**- Commencement of Classes for II, III, IV Year UG** - IQAC Meeting
19.08.21	Thursday	
20.08.21	Friday	**Muharram - Holiday**
21.08.21	Saturday	Submission of IQAC Meeting Minutes by IQAC Coordinator to Principal
23.08.21	Monday	Submission of Status of Study Material(Soft Copy) to Principal by HODs
24.08.21	Tuesday	
25.08.21	Wednesday	
26.08.21	Thursday	Class Committee Meeting I for II, III & IV Year
27.08.21	Friday	Class Committee Meeting I for II, III & IV Year
28.08.21	Saturday	**Working day**
30.08.21	Monday	**Krishna Jayanthi - Holiday**
31.08.21	Tuesday	- Submission of CCM- I Minutes & Action taken report to Principal by HODs - Submission of stock verification report

NO. OF WORKING DAYS : 10

KINGS COLLEGE OF ENGINEERING

Academic Calendar Academic Year 2021-2022 (Odd Semester)

SEPTEMBER 2021

DATE	DAY	Events
01.09.21	Wednesday	Staff Council Meeting
02.09.21	Thursday	
03.09.21	Friday	
04.09.21	Saturday	**Holiday**
06.09.21	Monday	
07.09.21	Tuesday	
08.09.21	Wednesday	
09.09.21	Thursday	Submission of DRM Minutes by HODs to IQAC Coordinator
10.09.21	Friday	**Vinayagar Chaturthi – Holiday**
11.09.21	Saturday	**Working day**
13.09.21	Monday	
14.09.21	Tuesday	
15.09.21	Wednesday	- Submission of DRC Meeting Minutes by DRC Convener to Principal - IQAC Meeting
16.09.21	Thursday	- Submission of Assignment I Status to Principal by HODs - Submission of Continuous Assessment Test I Question Papers to CCE office
17.09.21	Friday	Staff Appraisal Feed Back Collection
18.09.21	Saturday	- Submission of IQAC Meeting Minutes by IQAC Coordinator to Principal - Submission of Syllabus Completion Report by HODs
20.09.21	Monday	**Continuous Assessment Test I Commences for UG II, III, IV Year**
21.09.21	Tuesday	
22.09.21	Wednesday	
23.09.21	Thursday	
24.09.21	Friday	
25.09.21	Saturday	**- Working day** **- Continuous Assessment Test I Ends for UG II, III, IV Year**
27.09.21	Monday	Class Committee Meeting II for II, III & IV Year
28.09.21	Tuesday	Class Committee Meeting II for II, III & IV Year
29.09.21	Wednesday	Submission of Continuous Assessment Test I Result Analysis by HODs
30.09.21	Thursday	- Submission of CCM- II Minutes & Action taken report to Principal by HODs - Counseling I for II, III & IV Year

NO. OF WORKING DAYS : 24

KINGS COLLEGE OF ENGINEERING

Academic Calendar Academic Year 2021-2022 (Odd Semester)

OCTOBER 2021

DATE	DAY	Events
01.10.21	Friday	Review Meeting with Principal
02.10.21	Saturday	**Gandhi Jayanthi - Holiday**
04.10.21	Monday	
05.10.21	Tuesday	Submission of Counseling I Report by Coordinator to IQAC Coordinator
06.10.21	Wednesday	Staff Council Meeting
07.10.21	Thursday	
08.10.21	Friday	
09.10.21	Saturday	**Working day**
11.10.21	Monday	Submission of DRM Minutes by HODs to IQAC Coordinator
12.10.21	Tuesday	
13.10.21	Wednesday	- Submission of Continuous Assessment Test II Question Papers to CCE office - Submission of Assignment II (PCE Activity) Status to Principal by HODs - Submission of Syllabus Completion Report by HODs
14.10.21	Thursday	**Ayudha Pooja - Holiday**
15.10.21	Friday	**Vijaya Dasami - Holiday**
16.10.21	Saturday	
18.10.21	Monday	- Submission of DRC Meeting Minutes by DRC Convener to Principal **- Continuous Assessment Test II Commences for UG II, III, IV Year**
19.10.21	Tuesday	**Milad-un-Nabi - Holiday**
20.10.21	Wednesday	IQAC Meeting
21.10.21	Thursday	
22.10.21	Friday	
23.10.21	Saturday	**- Working day** - Submission of IQAC Meeting Minutes by IQAC Coordinator to Principal
25.10.21	Monday	**Continuous Assessment Test II Ends for UG II, III, IV Year**
26.10.21	Tuesday	Class Committee Meeting III for II, III & IV Year
27.10.21	Wednesday	Class Committee Meeting III for II, III & IV Year
28.10.21	Thursday	Submission of Continuous Assessment Test II Result Analysis by HODs
29.10.21	Friday	Review Meeting with Principal
30.10.21	Saturday	Submission of CCM- III Minutes & Action taken report to Principal by HODs

NO. OF WORKING DAYS : 22

KINGS COLLEGE OF ENGINEERING

Academic Calendar Academic Year 2021-2022 (Odd Semester)

NOVEMBER 2021

DATE	DAY	Events
01.11.21	Monday	
02.11.21	Tuesday	
03.11.21	Wednesday	Staff Council Meeting
04.11.21	Thursday	**Deepavali - Holiday**
05.11.21	Friday	
06.11.21	Saturday	**- Working day** - Counseling II for II, III & IV Year
08.11.21	Monday	Zeroth Project review for Final year UG
09.11.21	Tuesday	Submission of Counseling II Report by Coordinator to IQAC Coordinator
10.11.21	Wednesday	- Submission of DRM Minutes by HODs to IQAC Coordinator - Submission of Syllabus Completion Report by HODs
11.11.21	Thursday	**- Revision classes (Phase I) Commences** for II, III & IV Year - Submission of Model Exam Question Papers to CCE office
12.11.21	Friday	
13.11.21	Saturday	**Revision classes (Phase I) Ends** for II, III & IV Year
15.11.21	Monday	**- Model Exam: Theory 1** for UG II, III, IV Year - Submission of DRC Meeting Minutes by DRC Convener to Principal
16.11.21	Tuesday	**Model Exam: Theory 2** for UG II, III, IV Year
17.11.21	Wednesday	**- Model Exam: Theory 3** for UG II, III, IV Year - IQAC Meeting
18.11.21	Thursday	**Model Exam: Theory 4** for UG II, III, IV Year
19.11.21	Friday	**Model Exam: Theory 5** for UG II, III, IV Year
20.11.21	Saturday	**- Working day** **- Model Exam: Theory 6** for UG II, III, IV Year - Submission of IQAC Meeting Minutes by IQAC Coordinator to Principal
22.11.21	Monday	**Model Practical Examinations**
23.11.21	Tuesday	**Model Practical Examinations**
24.11.21	Wednesday	**- Model Practical Examinations** - Submission of Model Exam Result Analysis by HODs
25.11.21	Thursday	- Review Meeting with Principal **- Revision classes (Phase II) Commences** for II, III & IV Year
26.11.21	Friday	
27.11.21	Saturday	
29.11.21	Monday	
30.11.21	Tuesday	**- Last Working day** **- Revision classes (Phase II) Ends** for II, III & IV Year

NO. OF WORKING DAYS : 25

KINGS COLLEGE OF ENGINEERING

Academic Calendar Academic Year 2021-2022 (Odd Semester)

DECEMBER 2021

DATE	DAY	Events
01.12.21	Wednesday	Staff Council Meeting
02.12.21	Thursday	**Commencement of Practical Examinations**
03.12.21	Friday	
04.12.21	Saturday	**Holiday**
06.12.21	Monday	
07.12.21	Tuesday	
08.12.21	Wednesday	ISO Internal Audit Commences
09.12.21	Thursday	
10.12.21	Friday	Submission of DRM Minutes by HODs to IQAC Coordinator
11.12.21	Saturday	
13.12.21	Monday	**Commencement of End Semester Examinations**
14.12.21	Tuesday	
15.12.21	Wednesday	- Submission of DRC Meeting Minutes by DRC Convener to Principal - IQAC Meeting
16.12.21	Thursday	ISO Internal Audit Ends
17.12.21	Friday	Submission of Subject Allocation Report for next semester
18.12.21	Saturday	Submission of IQAC Meeting Minutes by IQAC Coordinator to Principal
20.12.21	Monday	Submission of Report on Stock Verification, ISO Internal Audit by coordinators
21.12.21	Tuesday	
22.12.21	Wednesday	
23.12.21	Thursday	
24.12.21	Friday	
25.12.21	Saturday	**Christmas - Holiday**
27.12.21	Monday	
28.12.21	Tuesday	
29.12.21	Wednesday	
30.12.21	Thursday	
31.12.21	Friday	Last Date for submission of LM, QB for next semester

NO. OF WORKING DAYS : 25

J. [signature] 11/8/2021.

PRINCIPAL

CC: Secretary/ CEO
VP/HODs/ AO
DW-Hostels/Transport/Canteen/HS-GH

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ACADEMIC YEAR 2021 – 22 ODD SEMESTER

GUIDELINES FOR TIMETABLE PREPARATION

- Due to Covid'19 classes will be conducted through online mode.
- College Timing is changed to 9.30 AM to 4.00 PM. (5 Periods / Day) (60 Min / Period)
- 15 minutes break will be given in between classes

1	2	3	4	01.00 pm - 01.45 pm	5	6
09.30am - 10.30am	10.45am - 10.45am	12.00pm - 01.00pm	11.55am - 12.45pm	Lunch	01.45pm - 02.45pm	03.00pm - 04.00pm

- Lecture Hours
  - Maximum 5 to 6 periods allocated for tough Subjects (Credit 4 or Tutorial) and 3 to 4 periods allocated for remaining subjects (Credit 3).
  - Toughest subject is selected by concern HOD based on the results obtained in the previous year.
  - Tutorial Subjects / Elective Subjects must be mentioned in timetable itself
- Lab Hours
  - **Hours will be allocated based on Tamilnadu Govt. & Anna University Guidelines**
- Excess Hours
  - Excess Hours will be implemented in Saturdays
    - II Year – Mini Project/ Refresher Course – 1 or 2 periods / Week
    - III Year – GATE Coaching & Value Added Course – 1 or 2 periods / Week
  - Allocate 1 hr for NPTEL/Swayam for all year
- Training & Placement Hour
  - Allocate 2 Hrs / week to all department students.
  - II year & III year
    - Soft Skill – 1 period / Week
    - Aptitude – 1 periods / Week
  - IV Year
    - Soft skill – 2 periods / Week
    - Aptitude – 2 periods / Week
- PCE or Professional Society Activities will be conducted on saturday
- Timetable format is continued.

4/8/21
OVERALL TIMETABLE COORDINATOR

04/8/2021
PRINCIPAL

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR 2020– 2021 (EVEN SEMESTER)

CIRCULAR

DATE: 14.6.2021

Due to Covid 19 (Second wave), Subject allocation will be done in online mode. Staff members are requested to mention their willingness to opt Theory & Laboratory papers for the forthcoming academic year **2021-2022 Odd semester.** Google form shared through our department whatsapp group (CSE STAFF CORNER)

- Senior & experienced faculties shall prefer to opt Tough / Problematic paper thereby helping in securing good results.
- We will convene department meeting to finalize papers on 19.6.2021 through google meet. Google meet link will be shared in our Whatsapp group

Encl:

1. Link of Google form - https://forms.gle/5msWnLbGqqTBLrmcA

14/6/21
HOD/CSE

Subject Allocation 2021-22 Odd Semester

* Required

1. Email *

____

2. Staff Name:(Ex. Mr.Arun.M) *

____

3. Willing subject THEORY. (Kindly select any three THEORY subjects) *

Check all that apply.

- [ ] CS8792 Cryptography and Network Security- IV YEAR
- [ ] CS8791 Cloud Computing- IV YEAR
- [ ] Open Elective II- IV YEAR
- [ ] Professional Elective II- IV YEAR
- [ ] Professional Elective III- IV YEAR
- [ ] CS8591 Computer Networks- III YEAR
- [ ] CS8501 Theory of Computation- III YEAR
- [ ] CS8592 Object Oriented Analysis and Design- III YEAR
- [ ] Open Elective I- III YEAR
- [ ] CS8391 Data Structures- II YEAR
- [ ] CS8392 Object Oriented Programming -II YEAR
- [ ] GE8151 Problem Solving and Python Programming- I YEAR
- [ ] Fundamentals of C and Data structures- II ECE
- [ ] OOPS- III EEE

4. Willing subject LAB. (Kindly select any two LAB subjects) *

Check all that apply.

- [ ] CS8381 Data Structures Laboratory -II YEAR
- [ ] CS8383 Object Oriented Programming Laboratory -II YEAR
- [ ] CS8382 Digital Systems Laboratory -II YEAR
- [ ] CS8582 Object Oriented Analysis and Design Laboratory- III YEAR
- [ ] CS8581 Networks Laboratory - III YEAR
- [ ] CS8711 Cloud Computing Laboratory -IV YEAR
- [ ] IT8761 Security Laboratory - IV YEAR
- [ ] GE8161 Problem Solving and Python Programming Laboratory -I YEAR
- [ ] Fundamentals of C and Data structure Lab- II ECE
- [ ] OOPS lab- III EEE
- [ ] IV YEAR Project Work

5. Comment if any.

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18/6/21

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR 2020 – 2021 (EVEN SEMESTER)

WILLINGNESS CHART FOR SUBJECT ALLOCATION FOR ACADEMIC YEAR 2021 – 2022 (ODD SEMESTER)

STAFF NAME	SUB 1	SUB 2	SUB 3	LAB 1	LAB 2
Dr.S.M.Uma	CS8592 Object Oriented Analysis and Design- III YEAR	Open Elective II- IV YEAR	CS8591 Computer Networks- III YEAR	IV YEAR Project Work	
K.Abhirami	CS8391 Data Structures- II YEAR	Professional Elective III- IV YEAR	CS8791 Cloud Computing- IV YEAR	CS8381 Data Structures Laboratory -II YEAR	IV YEAR Project Work
S.Puvaneswari	CS8791 Cloud Computing- IV YEAR	CS8501 Theory of Computation- III YEAR	CS8391 Data Structures- II YEAR	CS8381 Data Structures Laboratory -II YEAR	CS8711 Cloud Computing Laboratory - IV YEAR
B.Sangeetha	Professional Elective III- IV YEAR	CS8791 Cloud Computing- IV YEAR	CS8592 Object Oriented Analysis and Design- III YEAR	CS8582 Object Oriented Analysis and Design Laboratory- III YEAR	CS8381 Data Structures Laboratory -II YEAR
S.Rajarajan	CS8792 Cryptography and Network Security- IV YEAR	Open Elective II- IV YEAR	CS8392 Object Oriented Programming -II YEAR	IT8761 Security Laboratory - IV YEAR	CS8381 Data Structures Laboratory -II YEAR
Dr.D.Sivakumar	CS8591 Computer Networks- III YEAR	CS8391 Data Structures- II YEAR	CS8392 Object Oriented Programming -II YEAR	CS8581 Networks Laboratory - III YEAR	CS8383 Object Oriented Programming Laboratory -II YEAR

STAFF NAME	SUB 1	SUB 2	SUB 3	LAB 1	LAB 2
R.Suganthalakshmi	Open Elective II- IV YEAR	Professional Elective III- IV YEAR	Open Elective I- III YEAR	CS8581 Networks Laboratory - III YEAR	CS8383 Object Oriented Programming Laboratory -II YEAR
R.Sriramkumar	CS8791 Cloud Computing- IV YEA	Open Elective I- III YEAR	CS8592 Object Oriented Analysis and Design- III YEAR	CS8582 Object Oriented Analysis and Design Laboratory- III YEAR	CS8711 Cloud Computing Laboratory -IV YEAR
G.Chandrapraba	CS8392 Object Oriented Programming -II YEAR	Open Elective II- IV YEAR	CS8501 Theory of Computation- III YEAR	CS8383 Object Oriented Programming Laboratory -II YEAR	CS8381 Data Structures Laboratory -II YEAR
M.Arun	CS8791 Cloud Computing- IV YEA	CS8392 Object Oriented Programming -II YEAR	OOPS- III EEE	CS8383 Object Oriented Programming Laboratory -II YEAR	OOPS lab- III EEE

S8. Ravi 21/6/21
(SUBJECT ALLOCATION INCHARGE)

HOD/CSE 21/6/21

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR 2021 – 2022 (ODD SEMESTER)

COMPETENCY MATRIX FOR SUBJECT ALLOCATION

SNO	SUBJECT	STAFF NAME	S.M.UMA	K.ABHIRAMI	S.PUVANESWARI	B.SANGEETHA	S.RAJARAJAN	D.SIVAKUMAR	R.SUGANTHALAKSHMI	R.SRIRAMKUMAR	M.ARUN	G.CHANDRA PRABA
I YEAR												
1.		Problem Solving & Python Programming		**	**	***	***		***	***	***	**
2.		Problem Solving & Python Programming Lab		**					***	***	**	
II YEAR												
3.	CS8391	Data Structures	**	***	**	**	**				**	**
4.	CS8392	Object Oriented Programming						***			**	***
5.	CS8381	Data Structures Lab		***	**	**	**					**
6.	CS8383	OOPs Lab						***			**	***

SNO	SUBJECT \ STAFF NAME		S.M.UMA	K.ABHIRAMI	S.PUVANESWARI	B.SANGEETHA	S.RAJARAJAN	D.SIVAKUMAR	R.SUGANTHALAKSH	R.SRIRAMKUMAR	M.ARUN	G.CHANDRA PRABA
III YEAR												
7.	CS8591	Computer Networks	**	**	**		**	***				
8.	CS8501	Theory of Computation			***							
9.	CS8592	Object Oriented Analysis & Design	***			**						
10.	OMF551	Product Design & Development							***	*	*	
11.	CS8582	Object Oriented Analysis & Design Laboratory								**		
12.	CS8581	Networks Laboratory				**		***	***			**
IV YEAR												
13.	CS8792	Cryptography & Network Security		**	**		***	***		**		
14.	CS8791	Cloud Computing			**	**				**	***	
15.	IT8075	Software Project Management (Prof.Elective – II)	**		***	**				**		

SNO	SUBJECT	STAFF NAME	S.M.UMA	K.ABHIRAMI	S.PUVANESWARI	B.SANGEETHA	S.RAJARAJAN	D.SIVAKUMAR	R.SUGANTHALAK	R.SRIRAMKUMAR	M.ARUN	G.CHANDRA PRABA
16.	CS8088	Wireless Adhoc & Sensor Networks (PE –III)	**		*	**		**			*	
17.	OME752	Supply Chain Management (Open Elective - II)							**			**
18.	CS8711	Cloud Computing Laboratory			***	**				**		
19.	IT8761	Security Laboratory					***					
20.	EC8393	Fundamentals of Data structures in C (II ECE)		**	**			**			**	**
21.	EC8381	Fundamentals of Data structures in C Lab (II ECE)			**	**		**				**
22.	CS8392	Object Oriented Programming (III EEE)						**			***	**
23.	CS8383	OOPs Lab (III EEE)				**		**			***	**
24.	OCS752	Introduction to C Programming (IV EEE)					**		**		**	

* Willing to handle ** Capable of Handling *** Expertise

S. Puv 21/6/21
PREPARED BY
(Mrs.S.Puvaneswari AP/CSE)

21/6/21
APPROVED BY
(Dr.S.M.Uma HOD/ CSE)

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
ACADEMIC YEAR 2021 – 2022 (ODD SEMESTER)
STAFF WORKLOAD

SNO	STAFF NAME	THEORY / PRACTICAL WITH SUB.CODE	CLASS / BRANCH WITH CLASS STRENGTH
1.	Dr.S.M.Uma HOD/CSE	T1: CS8592 - Object Oriented Analysis & Design L1: UG Project Phase I	T1: III CSE (49) L1: IV CSE
2.	Ms.K.Abhirami (HEAD IQAC)	T1: CS8391 – Data Structure L1: CS8381 – Data Structures Lab	T1: II CSE (63) L1: II CSE (63)
3.	Ms.S.Puvaneswari	T1: CS8503 - Theory of Computation T1: IT8075 – Software Project Management L1: CS8711 – Cloud Computing Lab L2: GE8161 – Problem Solving & Python Programming Lab	T1: III CSE (45) T2: II ECE (47) L1: II ECE (47) L2: I Year
4.	Ms.B.Sangeetha	T1: CS8088 – Wireless Adhoc & Sensor Networks T2: GE8161 – Problem Solving & Python Programming L1: EC8381- Fundamentals of Data structures in C Lab (M) L2: GE8161 – Problem Solving & Python Programming Lab	T1: IV CSE (44) T2: I Year L1: II ECE (42) L2: I Year
5.	Mr.S.Rajarajan (Class Incharge – IV CSE)	T1 : CS8792 – Cryptography & Network Security T2: GE8151 – Problem Solving & Python Programming L1: IT8761 – Security Lab L2: GE8161 – Problem Solving & Python Programming Lab	T1: IV CSE (44) T2: I Year L1: IV CSE(44) L2: I Year
6.	Dr.D.Sivakumar	T1: EC8393 – Fundamentals of Data Structures in C T2: CS8591 - Computer Networks L1: CS8581 – Networks Lab L2: GE8161 – Problem Solving & Python Programming Lab	T1: II ECE(42) T2: III CSE(49) L1: II CSE (51) L2: I Year
7.	Ms.R.Sugantha Lakshmi	T1: OME752 – Supply Chain Management T2: OCS752 – Introduction to C Programming L1: Communication Networks Lab L2: GE8161 – Problem Solving & Python Programming Lab	T1: IV CSE (44) T2: IV EEE L1: III ECE (45) L2: I Year
8.	Mr.R.Sriramkumar (Class Incharge – III CSE)	T1: OMF551 – Product Design & Development T2: GE8151 – Problem Solving & Python Programming L1: CS8582 - Object Oriented Analysis & Design Laboratory L2: GE8161 – Problem Solving & Python Programming Lab	T1: III CSE (49) T2: I Year L1: III CSE (49) L2: I Year
9.	Mr.M.Arun	T1: CS8791 – Cloud Computing T2: CS8392 – OOP L1: CS8393 – OOP Lab L2: GE8161 – Problem Solving & Python Programming Lab	T1: IV CSE (44) T2: III EEE L1: III EEE L2: I Year

SNO	STAFF NAME	THEORY / PRACTICAL WITH SUB.CODE	CLASS / BRANCH WITH CLASS STRENGTH
10.	Ms.G.Chandra Praba **(Class Incharge – II CSE)**	T1: CS8392 – OOP T2: GE8151 – Problem Solving & Python Programming L1: CS8393 – OOP Lab L2: GE8161 – Problem Solving & Python Programming Lab	T1: II CSE (63) T2: I Year L1: II CSE(63) L2: I Year
11.	New staff (R.Ranitha)	T1: GE8151 – Problem Solving & Python Programming L1: GE8161 – Problem Solving & Python Programming Lab	T1: I Year L1: I Year

24/7/21
HOD/CSE

J. [signature] 29/7/2021.
PRINCIPAL

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
ACADEMIC YEAR 2021 – 2022 (ODD SEMESTER)
CLASSWISE SUBJECT ALLOCATION RECORD

II YEAR

SUB CODE	SUBJCT NAME	STAFF NAME
MA8351	Discrete Mathematics	Dr.R.Suresh
CS8351	Digital Principles and System Design	Mr.W.Newton David Raj
CS8391	Data Structures	Ms.K.Abhirami
CS8392	Object Oriented Programming	Ms.G.Chandraprabha
EC8395	Communication Engineering	Mr.R.Balakrishnan
CS8381	Data Structures Laboratory	Ms.B.Sangeetha
CS8382	Digital Systems Laboratory	Mr. W. Newton David Raj & Mr.K.Sudarsan
CS8383	Object Oriented Programming Laboratory	Ms.G.Chandrapraba
HS8381	Interpersonal Skills/ Listening & Speaking	Mr.J.Radhakrishnan

III YEAR

SUB CODE	SUBJCT NAME	STAFF NAME
MA8551	Algebra and Number Theory	Dr.G.Jeyakrishnan
CS8591	Computer Networks	Dr.D.Sivakumar
EC8691	Microprocessor & Microcontroller	Mr.R.Thandayuthapani
CS8501	Theory of Computation	Ms.S.Puvaneswari
CS8592	Object Oriented Analysis & Design	Dr.S.M.Uma
OMF551	Product Design and Development	Mr.R.Sriramkumar
EC8681	Microprocessor & Microcontroller Lab	Mr.R.Thandayuthapani
CS8582	Object Oriented Analysis & Design Lab	Mr.R.Sriramkumar
CS8581	Networks Lab	Dr.D.Sivakumar

IV YEAR

SUB CODE	SUBJCT NAME	STAFF NAME
MG8591	Principles of Management	Mr.B.Sureshbabu
CS8792	Cryptography and Network Security	Mr.S.Rajarajan
CS8791	Cloud Computing	Mr.M.Arun
OME752	Supply Chain Management	Ms.R.Suganthalakshmi
IT8075	Software Project Management	Ms.S.Puvaneswari
CS8088	Wireless Adhoc& Sensor Network	Ms.B.Sangeetha
CS8711	Cloud Computing Laboratory	Ms.S.Puvaneswari
IT8761	Security Laboratory	Mr.S.Rajarajan

HOD/CSE

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SUBJECT: THEORY OF COMPUTATION

SEMESTER: V

QUESTION BANK (CS8501)

(Version: 3)

PREPARED BY

Ms.S.PUVANESWARI / CSE

CS8501 THEORY OF COMPUTATION

L T P C
3 0 0 3

UNIT I AUTOMATA FUNDAMENTALS 9

Introduction to formal proof – Additional forms of Proof – Inductive Proofs –Finite Automata – Deterministic Finite Automata – Non-deterministic Finite Automata – Finite Automata with Epsilon Transitions

UNIT II REGULAR EXPRESSIONS AND LANGUAGES 9

Regular Expressions – FA and Regular Expressions – Proving Languages not to be regular – Closure Properties of Regular Languages – Equivalence and Minimization of Automata.

UNIT III CONTEXT FREE GRAMMAR AND LANGUAGES 9

CFG – Parse Trees – Ambiguity in Grammars and Languages – Definition of the Pushdown Automata – Languages of a Pushdown Automata – Equivalence of Pushdown Automata and CFG, Deterministic Pushdown Automata.

UNIT IV PROPERTIES OF CONTEXT FREE LANGUAGES 9

Normal Forms for CFG – Pumping Lemma for CFL – Closure Properties of CFL – Turing Machines – Programming Techniques for TM.

UNIT V UNDECIDABILITY 9

Non Recursive Enumerable (RE) Language – Undecidable Problem with RE – Undecidable Problems about TM – Post‘s Correspondence Problem, The Class P and NP.

TOTAL : 45PERIODS

SIGNATURE OF STAFF INCHARGE HOD/CSE
(Ms.S.Puvaneswari AP / CSE)

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
COURSE PLAN

Sub. Code	: CS8501	**Branch / Year / Sem**	: B.E CSE / III / V
Sub.Name	: Theory of Computation	**Batch**	: 2019-2023
Staff Name	: Ms.S.Puvaneswari	**Academic Year**	: 2021-22 (ODD)

COURSE OBJECTIVE

1. To understand the language hierarchy
2. To construct automata for any given pattern and find its equivalent regular expressions
3. To design a context free grammar for any given language
4. To understand Turing machines and their capability
5. To understand undecidable problems and NP class problems

TEXT BOOK

T1: J.E.Hopcroft, R.Motwani and J.D Ullman, —Introduction to Automata Theory, Languages and Computations, Second Edition, Pearson Education, 2003.

REFERENCES

R1: H.R.Lewis and C.H.Papadimitriou, —Elements of the theory of Computation, Second Edition, PHI, 2003.

R2: J.Martin, —Introduction to Languages and the Theory of Computation, Third Edition, TMH, 2003.

R3: Micheal Sipser, —Introduction of the Theory and Computation, Thomson Brokecole, 1997.

WEB RESOURCES

W1. http://math.uaa.alaska.edu/~afkjm/cs351/handouts/finite-auotmata.ppt **(Topic No.4)**

W2. www.cs.rpi.edu/~moorthy/Courses/modcomp/slides/Regular_Properties.ppt **(Topic No. 11)**

W3. https://nptel.ac.in/courses/106103070/# **(Topic No.18)**

W4. www.cs.rpi.edu/~moorthy/Courses/modcomp/slides/Turing.ppt **(Topic No.23)**

W5. web.cs.wpi.edu/~kal/courses/fcs/module9/grahneclass18reandrec.ppt **(Topic No.25)**

Topic No	Topic	Books for Reference	Page No.	Teaching Methodology	No. of Hours Required	Cumulative No. of periods
UNIT I	**AUTOMATA FUNDAMENTALS**					**9**
1.	Introduction to formal proof	T1	5 - 13	BB / PPT	1	1
2.	Additional forms of Proof	T1	13 – 17	BB / PPT	1	2
3.	Inductive Proofs	T1	19 - 26	BB / PPT	1	3
4.	Finite Automata	T1 W1	37 -45	PPT	1	4
5.	DFA	T1 R1	45 – 52 55 - 62	BB / PPT	1	5
6.	NFA	T1	55 – 60	VIDEO	2	7
7.	Finite Automata with Epsilon Transitions	T1	72 – 77	VIDEO	2	9
LEARNING OUTCOME Upon the completion of this unit, students should be able to • Understand the various mathematical proving techniques • Understand the basic concepts of finite automata • Convert NFA to DFA						
UNIT II	**REGULAR EXPRESSIONS AND LANGUAGES**					**9**
8.	Regular Expressions	T1 R2	85 – 88 92 - 95	BB / PPT	2	11
9.	FA and Regular Expressions	T1	92 - 107	VIDEO	3	14
10.	Proving Languages not to be regular	T1	128 – 130	BB / PPT	1	15
11.	Closure Properties of Regular Languages	T1 W2	133 – 146	PPT	1	16
12.	Equivalence and Minimization of Automata.	T1	155 – 165	VIDEO	2	18
LEARNING OUTCOME Upon the completion of this unit, students should be able to • Define the regulation expression • Understand the relationship between FA and Regular expression • Prove that the given language is regular or not						
UNIT III	**CONTEXT FREE GRAMMAR AND LANGUAGES**					**9**
13.	CFG	T1	171 - 181	BB / PPT	2	20
14.	Parse Trees	T1	183 - 192	SIM	1	21
15.	Ambiguity in Grammars and Languages	T1	207 - 214	VIDEO	1	22
16.	Definition of the Pushdown Automata	T1	225 - 232	BB / PPT	1	23
17.	Languages of a Pushdown Automata	T1	234 - 240	VIDEO	2	25
18.	Equivalence of Pushdown Automata and CFG	T1 W3	243 - 250	NPTEL	1	26
19.	Deterministic Pushdown Automata.	T1	252 -255	BB / PPT	1	27

Topic No	Topic	Books for Reference	Page No.	Teaching Methodology	No. of Hours Required	Cumulative No. of periods
LEARNING OUTCOME Upon the completion of this unit, students should be able to • Know about Context Free Grammar (CFG) and Parse Trees • Understand the concepts of Pushdown Automata • Understand the relationship between PDA , CFG and DPDA						
UNIT IV	**PROPERTIES OF CONTEXT FREE LANGUAGES**					**9**
20.	Normal Forms for CFG	T1	261 – 274	VIDEO	3	30
21.	Pumping Lemma for CFL	T1	279 – 285	BB / PPT	1	31
22.	Closure Properties of CFL	T1	287 – 296	BB / PPT	1	32
23.	Turing Machines	T1 W4	324 – 334	PPT	2	34
24.	Programming Techniques for TM.	T1	337 – 342	VIDEO	2	36
LEARNING OUTCOME Upon the completion of this unit, students should be able to • Understand the various types of Normal forms • Know the concepts of Turing Machines • Solve the problem using Turing Machines						
UNIT V	**UNDECIDABILITY**					**9**
25.	Non Recursive Enumerable (RE) Language	T1 W5	378 – 382	PPT	1	37
26.	Undecidable Problem with RE	T1	383 – 389	BB / PPT	2	39
27.	Undecidable Problems about TM	T1	392 – 399	BB / PPT	2	41
28.	Post‘s Correspondence Problem,	T1	401 – 411	VIDEO	2	43
29.	The Class P and NP.	T1 R3	426 – 434 256 - 258	VIDEO	2	45
LEARNING OUTCOME Upon the completion of this unit, students should be able to • Know the various concept of Non Recursive Language • Determine whether the problem is decidable or not. • Understand the basic concepts of Class P and NP						

COURSE OUTCOME

At the end of the course, the students will be able to

- Construct automata, regular expression for any pattern.
- Write Context free grammar for any construct.
- Design Turing machines for any language.
- Propose computation solutions using Turing machines.
- Derive whether a problem is decidable or not.

CONTENT BEYOND THE SYLLABUS

1. Tractable and Intractable Problems

INTERNAL ASSESSMENT DETAILS

ASST. NO.	I	II	MODEL
Topic Nos.	1-10	11-19	1-29
Date			

ASSIGNMENT DETAILS

ASSIGNMENT	I	II
Topic Nos. for reference	1-10	PCE
Deadline		

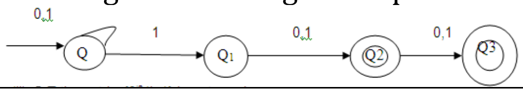
ASSIGNMENT I (50) (BEFORE CAT – I)	ASSIGNMENT II (50) (BEFORE CAT – II)
Topic No for reference: 1 – 10	**PCE Activity**
Part – A 1. Define Finite Automaton 2. Enumerate the difference between NFA and DFA 3. Write down the rules for Pumping Lemma for Regular languages 4. Define ambiguous grammar 5. What is meant by derivation? **Part – B** 1. Prove the equivalent of NFA and DFA using subset construction. 2. Explain in detail about Finite Automata with ε moves with an example 3. a.Construct a ε -NFA for the regular expression 10+(0+11)0*1. b.If G is the grammar S->SbS/a show that G is ambiguous.	**Activity – 1: GATE Question Paper Solving** ➢ Push down Automata ➢ Turing Machine **Activity – 2: Problem Solving** ➢ Chomsky Normal Form ➢ Greibach Normal Form **Activity – 3:Quiz** ➢ Parse trees ➢ Ambiguity in Context Free Grammar **Activity – 4:NPTEL Swayam Assignment** ➢ Turing Machines **Activity – 5:Mindmapping** ➢ Closure properties of Context Free language **Activity – 6:Simulation** ➢ PDA ➢ Turing Machines

COURSE ASSESSMENT PLAN

CO	CO Description	Weightage	CAT1	CAT2	MODEL	ASSIGN.-1	PCE	AU
CO1	Construct automata, regular expression for any pattern.	30%	√		√	√		
CO2	Write Context free grammar for any construct.	15%		√	√		√	
CO3	Design Turing machines for any language.	20%		√	√		√	
CO4	Propose computation solutions using Turing machines.	20%		√	√		√	
CO5	Derive whether a problem is decidable or not.	15%			√			

COURSE OUTCOME ALLIGNMENT MATRIX – MODEL EXAM SAMPLE QUESTION SET

Q.No	Question	Marks	CO	BTL	PI
1.	Define Finite Automata.	2	CO1	L1	1.4.1
2.	Outline the concepts of principle of mathematical induction	2	CO1	L2	1.3.1
3.	What is meant by regular expression?	2	CO1	L1	1.4.1
4.	Summarize the definition of pumping lemma for regular set.	2	CO1	L2	1.4.1
5.	Build CFG for a signed integer constant in C	2	CO2	L3	1.4.1
6.	Compare PDA acceptance by empty stack method with acceptance by the final state method	2	CO2	L2	2.2.4
7.	Illustrate the configuration of Turing Machine	2	CO3	L2	1.4.1
8.	Define simplification of CFG.	2	CO2	L1	1.4.1
9.	Identify the properties of recursive and recursive enumerable language	2	CO5	L3	2.1.2
10.	Apply the concept of decidability, show that halting problem is decidable or not?	2	CO5	L3	2.4.2
11. a.i	Prove the following by the principle of induction $\sum_{k=1} k^2 = \frac{n(n+1)(2n+1)}{6}$.	6	CO1	L5	2.4.1
11.a.ii	P.T A language is accepted by some DFA iff L is accepted by some NFA.	7	CO1	L5	2.4.1
11.b.i	Assess a non-deterministic finite automaton accepting the set of strings over {a,b} ending in aba. Use it to construct a DFA accepting the some set of strings.	6	CO1	L5	3.2.2

<table>
<tr><th>Q.No</th><th>Question</th><th>Marks</th><th>CO</th><th>BTL</th><th>PI</th></tr>
<tr><td>11.b.ii</td><td>Deduct into DFA for the following ε-NFA
<table>
<tr><td></td><td>ε</td><td>a</td><td>b</td><td>c</td></tr>
<tr><td>→ p</td><td>{q,r}</td><td>ø</td><td>{q}</td><td>{r}</td></tr>
<tr><td>q</td><td>ø</td><td>{p}</td><td>{r}</td><td>{p,q}</td></tr>
<tr><td>*r</td><td>ø</td><td>ø</td><td>ø</td><td>ø</td></tr>
</table></td><td>7</td><td>CO1</td><td>L5</td><td>3.4.1</td></tr>
<tr><td>12.a.i</td><td>Outline the steps to Convert the following NFA into regular expression.

</td><td>6</td><td>CO1</td><td>L2</td><td>3.4.1</td></tr>
<tr><td>12.a.ii</td><td>S.T the set L={0^{i^2} |i≥1} is not regular</td><td>7</td><td>CO1</td><td>L2</td><td>2.4.1</td></tr>
<tr><td>12.b.i</td><td>S.T the set L={0^n|n is a perfect square} is not regular</td><td>6</td><td>CO1</td><td>L2</td><td>2.4.1</td></tr>
<tr><td>12.b.ii</td><td>Illustrate the steps to Construct an NFA from the regular expression ((a|b)*a</td><td>7</td><td>CO1</td><td>L2</td><td>3.2.2</td></tr>
<tr><td>13.a.i</td><td>Construct a parse tree and compute left most derivation, rightmost derivation for a given input, (a+b) and a++</td><td>7</td><td>CO2</td><td>L3</td><td>3.2.2</td></tr>
<tr><td>13.a.ii</td><td>Construct a PDA that accept the given CFG: S→xaax, X→ax|bx|ε</td><td>6</td><td>CO2</td><td>L3</td><td>3.2.2</td></tr>
<tr><td>13.b.i</td><td>Solve that if L is N(M1)(Language accepted by empty stack) for some PDA M1,then L is N(M2)(Language accepted by final state) for some PDA.</td><td>7</td><td>CO2</td><td>L3</td><td>2.1.3</td></tr>
<tr><td>13.b.ii</td><td>Construct PDA for the language L={ww^R|w in $(a+b)^*$}.</td><td>6</td><td>CO2</td><td>L3</td><td>3.2.2</td></tr>
<tr><td>14.a</td><td>List the steps to convert the following grammar into an equivalent one with no unit productions and no useless symbols (Simplification of CFG) and convert into CNF form: S-> ABA, A->aAA|aBc|bB, B-> A | bB | Cb, C->CC | cC</td><td>13</td><td>CO2</td><td>L1</td><td>3.2.2</td></tr>
<tr><td>14.b</td><td>Show and explain in detail about programming techniques for TM</td><td>13</td><td>CO3</td><td>L1</td><td>2.1.2</td></tr>
<tr><td>15.a</td><td>Examine that L_{ne} is not recursive and also prove that L_{ne} is RE</td><td>13</td><td>CO5</td><td>L4</td><td>1.4.1</td></tr>
<tr><td>15.b</td><td>Analyze the concepts about RICE theorem and Simplify L_u is RE but not recursive</td><td>13</td><td>CO5</td><td>L4</td><td>1.4.1</td></tr>
<tr><td>16.a</td><td>Construct PDA from CFG. PDA is given by P=({p,q},{0,1},{X,Z},δ,q,Z), δ is defined by δ(p,1,Z)={(p,XZ)}, δ(p, ε,z)={(P, ε)}, δ(p, 1,x)={(p,XX)}, δ(q,1,X)={(q, ε)}, δ(p,0,X)={(q,X)}, δ(q,0,Z)={(p,Z)}</td><td>15</td><td>CO2</td><td>L6</td><td>2.1.3</td></tr>
<tr><td>16.b</td><td>Write down the steps to provide solution to the PCP problem
The TM M={{q1,q2,q3},{0,1},{0,1,B}, δ ,q1,B,{q3}} where δ is given by δ(q1,0)={(q2,1,R)}, δ(q1,1)={(q2,0,L)},</td><td>15</td><td>CO4</td><td>L6</td><td>2.2.3</td></tr>
</table>

	δ(q1,B)={(q2,1,L)}, δ(q2,0)={(q3,0,L)}, δ(q2,1)={(q1,0,R)}, δ(q1,B)={(q2,0,R)} and input string w=01. Build the solution.				

ASSESSMENT PAPER QUALITY MATRIX

PART	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
A	1,3,8	2,4,6,7	5,9,10			
B	14.a	12.a.i. & ii	13.a.i & ii	15.a.i & ii	11.a.i & ii	
	14.b	12.b.i & ii	13.b.i & ii	15.b.i &ii	11.b.i & ii	
C						16.a
						16.b
Total	**19**	**21**	**19**	**13**	**13**	**15**
Distribution	**40%**		**32%**		**28%**	

Prepared by
Ms.S.PUVANESWARI

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ACADEMIC YEAR 2021-2022 / ODD SEMESTER

Year/Sem : III / V

III CSE NAMELIST

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6.	821119104007	Aravind. A
7.	821119104008	Avudaiappan .A
8.	821119104009	Bakiya Lakshmi
9.	821119104010	Balakrishnan. M
10.	821119104011	Bavya. S
11.	821119104012	Bhavatharani .T
12.	821119104013	Deepika. P
13.	821119104014	Devipriya. S
14.	821119104015	Dharani. G
15.	821119104016	Divakaran. J
16.	821119104017	Elayadharshini
17.	821119104018	Fasila Afreen .J
18.	821119104019	Gokul .M
19.	821119104020	Gomathi .A
20.	821119104021	Gopinath. P
21.	821119104022	Govindharajan.
22.	821119104023	Kamali. K
23.	821119104024	Kanishkar .K
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28.	821119104029	Nandhini. J
29.	821119104031	Pavitha .P
30.	821119104032	Priyadharshini
31.	821119104033	Ramakrishnan .E
32.	821119104034	Rethinapriya. T
33.	821119104035	Sachin .R
34.	821119104037	Sathish .T
35.	821119104038	Selvabharathi. S
36.	821119104039	Shakthivel .M
37.	821119104040	Siva .G
38.	821119104041	Sivaranjani . S
39.	821119104043	Suguna. S
40.	821119104044	Suresh Karthik .J
41.	821119104045	Suruthi. S
42.	821119104046	Surya. A
43.	821119104047	Swetha. S
44.	821119104048	Tharanika. K
45.	821119104049	Varun. K
46.	821119104050	Vengatramanan.
47.	821119104051	Vignesh. K
48.	821119104052	Vikiramadhithan
49.	821119104053	Viswa .A

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
ACADEMIC YEAR 2021 – 2022 ODD SEMESTER
INDIVIDUAL STAFF TIMETABLE

STAFF NAME: Ms.S.Puvaneswari

Session / Day	1 09.30am - 10.30am	2 10.30am - 11.30am	11.30 am - 11.45 am	3 11.45am - 12.45pm	12.45 pm - 01.30 pm	4 01.30pm - 02.30pm	5 02.30pm - 04.00pm
MON			BREAK		LUNCH BREAK		
TUE				CS8501		IT8075	CS8711
WED	CS8501			IT8075			
THU						IT8075	CS8501
FRI						CS8501	
SAT		IT8075					

SUB CODE	SUB NAME	TUTORIAL / ELECTIVE	CREDITS	YEAR / SEM	PERIODS / WEEK	STRENGTH
THEORY						
CS8501	Theory of Computation		3	III / V	4	49
IT8075	Software Project Management		3	IV / VII	4	42
PRACTICAL						
CS8711	Cloud Computing Laboratory		2	IV / VII	2	42

S.Pu 18/8/21
DEPT TTC

S.Pu 18/8/21
STAFF INCHARGE

18/8/21
HOD/CSE

CS8501 – THEORY OF COMPUTATION

UNIT I AUTOMATA FUNDAMENTALS

Introduction to formal proof – Additional forms of Proof – Inductive Proofs –Finite Automata – Deterministic Finite Automata – Non-deterministic Finite Automata – Finite Automata with Epsilon Transitions

What is TOC?

- In theoretical computer science, the theory of computation is the branch that deals with whether and how efficiently problems can be solved on a model of computation, using an algorithm.
- The field is divided into three major branches:
  - automata theory,
  - computability theory and
  - computational complexity theory.
- In order to perform a rigorous study of computation, computer scientists work with a mathematical abstraction of computers called a model of computation.
- There are several models in use, but the most commonly examined is the Turing machine.

- In theoretical computer science, automata theory is the ***study of abstract machines*** and the computational problems that can be solved using these machines.
- These abstract machines are called automata. This automaton consists of
  - states (represented in the figure by circles), and
  - transitions (represented by arrows).

FORMAL PROOF

- Usually the **truth** of a statement is solved by a **detailed sequence of steps and reasons.**
- Computer scientists take the extreme view that a formal proof of the correctness of a program should go hand in hand with the writing of the program itself.

- Theory of computation is based on mathematical computations. A mathematical computations can be solved by any one of the techniques
  1. Proofs about sets.
  2. Proofs by contradiction.
  3. Proofs by counterexample.
  4. Deductive Proofs
  5. Inductive Proofs
  6. Structural Induction

Deductive Proofs

- A deductive proofs consists of a sequence of statements whose truth leads from some ***initial*** statements called ***Hypothesis*** to ***Conclusion.***
- Each step in the proof must follow, by some accepted logical principle from either the given facts or some of the previous statements in the deductive proof or a combination of these on statements.

Example

- "if H then C"
- The theorem proves by going from hypothesis H to a conclusion C.
- Example: Prove 2^x > x^2 if x >=4 using deductive proofs
- Solution
  - Given 2^x > x^2 where x >=4
  - Consider x = 5(x>=4)
  - LHS = 8 RHS = 25(true)
  - Hence if x >=4 then the given statement is true

ADDITIONAL FORMS OF PROOF

- Proofs about sets Definition of set:
  - Set is a collection of elements or items.
- Proving Equivalence about sets:
  - If A and B are 2 expressions, then every elements in the set A is in set B and every elements in set B is in set A.
  - Let us prove PUQ=QUP

PUQ=QUP

- LHS

	Statement	Justification
1	X is in PUQ	Given
2	X is in P or X is in Q	By Definition of Union
3	X is in Q or X is in P	By Definition of Union
4	X is in QUP	By Definition of Union from 3rd rule

- RHS

	Statement	Justification
1	X is in QUP	Given
2	X is in Q or X is in P	By Definition of Union
3	X is in P or X is in Q	By Definition of Union
4	X is in PUQ	By Definition of Union from 3rd rule

Theorem 1.10: $R \cup (S \cap T) = (R \cup S) \cap (R \cup T)$.

	Statement	Justification
1.	x is in $R \cup (S \cap T)$	Given
2.	x is in R or x is in $S \cap T$	(1) and definition of union
3.	x is in R or x is in both S and T	(2) and definition of intersection
4.	x is in $R \cup S$	(3) and definition of union
5.	x is in $R \cup T$	(3) and definition of union
6.	x is in $(R \cup S) \cap (R \cup T)$	(4), (5), and definition of intersection

Only if

	Statement	Justification
1.	x is in $(R \cup S) \cap (R \cup T)$	Given
2.	x is in $R \cup S$	(1) and definition of intersection
3.	x is in $R \cup T$	(1) and definition of intersection
4.	x is in R or x is in both S and T	(2), (3), and reasoning about unions
5.	x is in R or x is in $S \cap T$	(4) and definition of intersection
6.	x is in $R \cup (S \cap T)$	(5) and definition of union

Proof by contradiction (contrapositive)

- The contrapositive of the statements “if H then C” is “if not C then not H”.
- A statement and its contrapositive are either both true or false.

- Example: Prove PUQ=QUP using contradiction. Solution:
  1. By contradiction assume PUQ != QUP
  2. Now consider x is in Q or x is in P
  3. Then it also implies x is in P or x is in Q
  4. So the assumption is false
  5. Hence PUQ=QUP is proved

Proofs by Counterexample

- Prove the statements with an example for all possible conditions.
- Example
  - Prove All primes are odd.

  Solution

  Take counter example as 2 which is a prime number. But it is not an odd number.

  Hence this proves the given statement is false

SUMMARY

- Automata Theory
- Formal Proof Techniques
- Proof about sets
- Proof by contradiction
- Proof by counter example

Assignment

- Solve by Deductive proof method,
- R∩(S U T) = (R ∩ S) U (R ∩ T)

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UNIT I
AUTOMATA FUNDAMENTALS
PART – A

1.	**Formally define Deterministic Finite Automata (DFA).**	**(AU – ND 2020/ 2019)**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

- A finite-state machine that accepts or rejects strings of symbols and only produces a unique computation (or run) of the automaton for each input string.
- A DFA is a quintuple A=(Q, ∑, δ , q_0, F)

  Where Q- finite set of states
  ∑-finite set of input symbols
  q_0,∑, Q-is the start state
  F≤Q –is the set of final states
  δ : Q * ∑→Q-Transition function

2.	**State any four ways of theorem proving.**	**(AU – ND 2020)**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

The four ways of theorem proving are,

- Deductive
- If and only if
- Induction
- Proof by contradiction.

3.	**Prove by induction on n>=1 that $\sum_{i=1}^{n} 1/i(i+1) = n/(n+1)$**	**(AU – ND 2019)**	**UNDERSTAND BT - L2**	**CO1**	**PI 2.1.3**

Consider the two step approach for a proof by method of induction

i. **Basis:** Let n = 1 then
LHS = 0.5 and RHS = 1 / 2 = 0.5
Hence, LHS = RHS.

ii. **Induction hypothesis**: Consider n = n + 1 then,

LHS: $\sum_{i}^{n+1} 1/i(i+1) = \sum_{i}^{n} 1/i(i+1) + 1 / (n+1)(n+1+1)$

$= n / (n+1) + 1 / (n+1)(n+2)$
$= n (n+2) + 1 / ((n+1)(n+2))$
$= n^2 + 2n +1 / ((n+1)(n+2))$
$= (n+1) (n+1) / ((n+1)(n+2))$
$= (n+1) / (n+2)$

RHS: n / (n+1) = (n+1) / (n+1+1) = (n+1) / (n+2)

LHS =RHS Hence it is proved

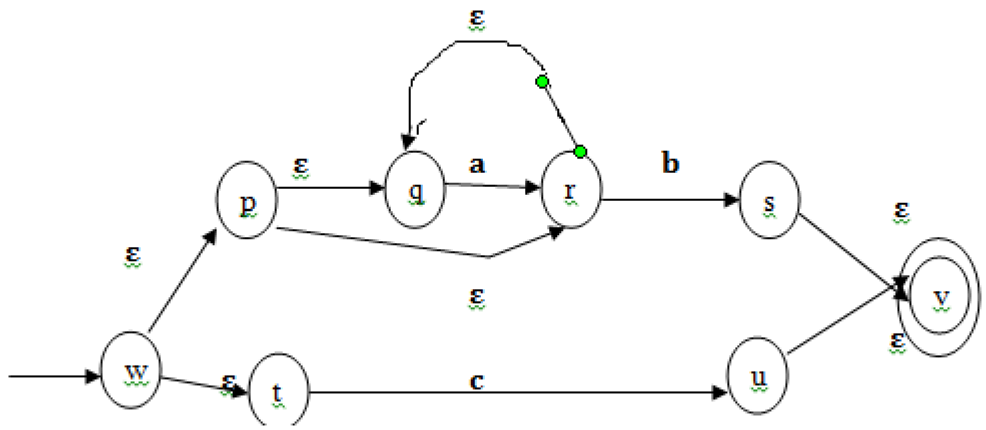
4.	**Define Finite Automata.**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

Finite Automata is a mathematical model of a system with discrete inputs and outputs. The system can be in any one of finite number of states and the state summarizes the history of past inputs and determines the behavior of the system for subsequent input.

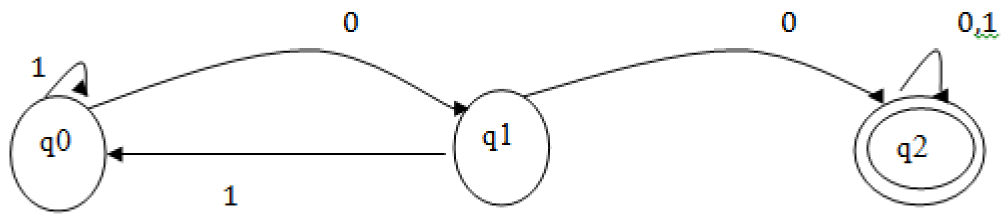
5.	**Define deductive proof.**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

A deductive proof consists of a sequence of statements whose truth leads from some initial statements called “Hypothesis” to “conclusion” statements. Each step in the proof must follow, by some accepted logical principal from either the given facts or some of the previous statements in the deductive proof or a combination of these.
Ex: “if H then C”. The theorem proves by going from hypothesis H to a conclusion C.

6.	**Generate NFA – ε to represent a*b|c**	**APPLY BT - L3**	**CO1**	**PI 3.2.1**



7.	**Design DFA to accept string over ∑=(0,1) with two consecutive 0’s.**	**APPLY BT - L3**	**CO1**	**PI 3.2.1**



8.	**Enumerate the difference between DFA and NFA.**	**UNDERSTAND BT - L2**	**CO1**	**PI 2.2.5**

S.No	DFA	NFA
1.	Every input string leads to the unique state of FA.	For the same input there can be more than one next state.
2.	Conversion of regular expression to DFA is complex.	Conversion is easier.
3.	DFA requires more memory for storing state information.	NFA requires more computations to match r.e with input.
4.	In DFA there is no ε-transitions.	In NFA ε-transitions are possible.

9.	**Define Automata theory.**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

In theoretical computer science, automata theory is the study of abstract machines (or more appropriately, abstract 'mathematical' machines or systems) and the computational problems that can be solved using these machines. These abstract machines are called automata. This automaton consists of

- states (represented in the figure by circles),
- Transitions (represented by arrows).

10.	**What are the applications of automata theory?**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

The automata theory can be applied ,

- In compiler construction.
- In switching theory and design of digital circuits.
- To verify the correctness of a program.
- Design and analysis of complex software and hardware systems.
- To design finite state machines such as Moore and Mealy machines.

11.	**What are the components of Finite automaton model?**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

The components of FA model are Input tape, Read control and finite control.

- The input tape is divided into number of cells. Each cell can hold one i/p symbol
- The read head reads one symbol at a time and moves ahead.
- Finite control acts like a CPU. Depending on the current state and input symbol read from the input tape it changes state.

12.	**Define finite state systems.**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

A finite state system or finite state machine is a "Mathematical model" of a system with certain input, and finally given an output. The input is processed by going through various states, and these states are called as intermediate state.

13.	**Prove 1+2+3+...+n = n (n + 1) / 2 using induction method.**	**UNDERSTAND BT - L2**	**CO1**	**PI 2.1.3**

Consider the two step approach for a proof by method of induction

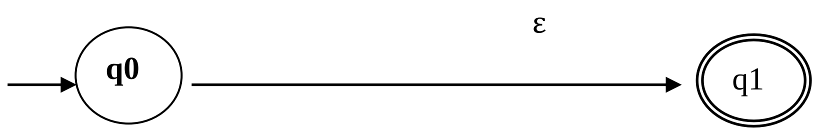
i. **Basis:** Let n = 1 then
LHS = 1 and RHS = 1 + 1 / 2 = 1
Hence, LHS = RHS.

ii. Induction hypothesis:
To prove 1 + β + γ +… + n = n (n + 1) / β + (n + 1)
Consider n = n + 1 then,
1 + β + γ+…+ n + (n + 1) = n (n + 1) / β + (n + 1) 2
= n + 3n + 2 / 2
= (n + 1) (n + 2) / 2

Thus it is proved that 1 + 2 + γ+ … + n = n (n + 1) / β.

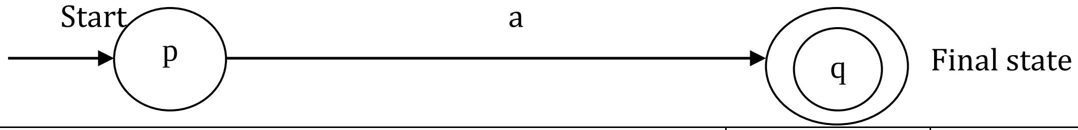
14.	**Define the term Epsilon transition.**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

The ε-transition means a move from one state to another state, without reading any symbol. NFA provides ε-transitions.



15.	**Define Transition diagram.**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

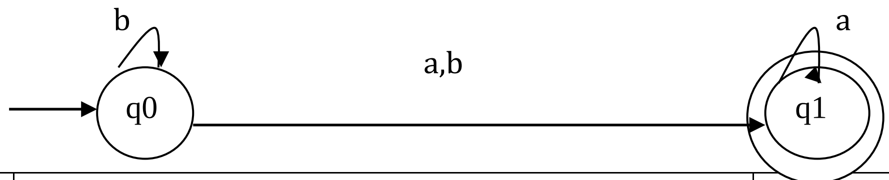
Transition diagram is a directed graph where vertices correspond to the states of the finite automata and arcs represent the transition from state p to q on input a.



16.	**What is Non Deterministic Finite Automaton?**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

The finite automata is called Non Deterministic Finite Automaton(usually denoted as NFA) if there exists more transitions for a specific input from current state to next state.NFA additionally have an epsilon(ε) transition.(i.e)transition from one state to another without reading input symbol.

Ex:



17.	**What is the principle of mathematical induction?**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

Let P(n) be a statement about a non negative integer n. Then the principle of mathematical induction is that P(n) follows from

- P(1) and
- P(n-1) implies P(n) for all n>1.

Condition(i) is called the basis step and condition (ii) is called the inductive step. P(n-1) is called the induction hypothesis.

18.	**What are the properties of transition function?**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

The properties of transition function are as follows:

- δ (q, ε)=q
- For all strings w and input symbol a Δ(q, aw)= į(į(q.a), w) Δ(q, wa)= į(į(q, w).a)
- The transition function δ can be extended that operates on states and strings.

19.	**What is meant by inductive proof?**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

The inductive proof is used to define the objects recursively. This follows 3 steps :

- Basis step-prove the statement for lowest value.
- Induction Hypothesis-assume the statement is true for value K.
- Inductive step-prove the statement is true for the value k+1.

20.	**What is meant by proof by contrapositive?**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

The contrapositive of the statement “ if H then C “ is If not C then not H “. A statement and its contrapositive are either both true or both false, so it can prove either to prove the other. A statement and its contrapositive are logically equivalent: if the statement is true, then its contrapositive is true, and vice versa.

21.	**What are the laws used to prove a statement?**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

- Additive inverse: a+(-a)=0
- Multiplicative inverse: a*1/a =1

- Absorption Law: AU(A∩B) = A, A∩(AUB)=A
- Demorgan's Law: (AUB)` = A` ∩ B`, (A∩B)` = A` U B`

22.	**What are the basic symbols used in the proof?**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

- U – Union
- ε - Empty String
- Φ – NULL set
- 7- negation
- ' – compliment
- = > implies

23.	**What is meant by proof by contradiction?**	**REMEMBER BT - L1**	**CO1**	**PI 1.4.1**

In logic, proof by contradiction is a form of proof that establishes the truth or validity of a proposition by first assuming that the opposite proposition is true, and then shows that such an assumption leads to a contradiction.

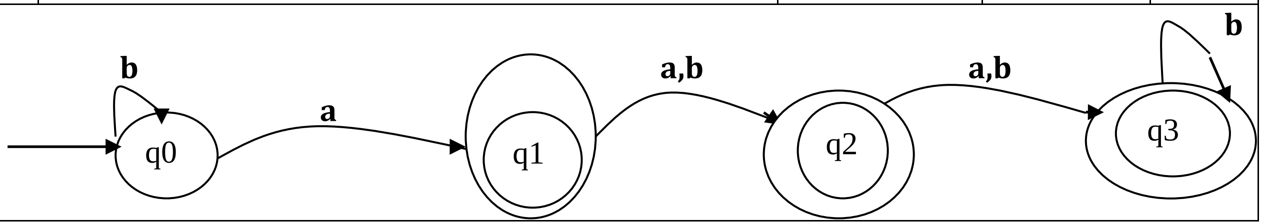
24.	**Justify " All primes are odd"**	**UNDERSTAND BT - L2**	**CO1**	**PI 2.4.4**

The problem can be solved by Proof by Contradiction. Assume the integer 2 is a prime but 2 is even. For any sets a,b,c if aΛb=Φ and c is a subset of b then prove that aΛc=Φ.
Given: aΛb=Φ and c subset of b
Assume: aΛc≠Φ
Then there exists x, xЄa and xЄc =>xЄb
=>aΛb≠Φ => aΛc=Φ (i.e., the assumption is wrong)

25.	**Why switching circuits are called as finite state systems?**	**UNDERSTAND BT - L2**	**CO1**	**PI 1.4.1**

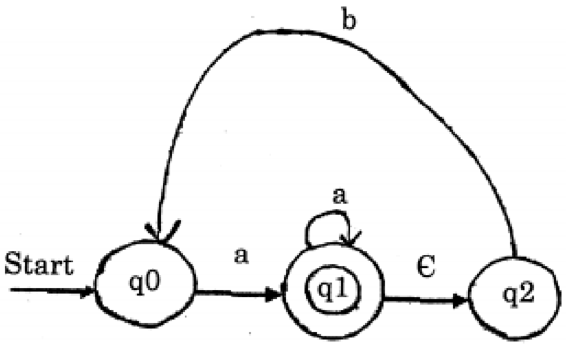
A switching circuit consists of a finite number of gates, each of which can be in any one of the two conditions 0 or 1. Although the voltages assume infinite set of values, the electronic circuitry is designed so that the voltages corresponding to 0 or 1 are stable and all others adjust to these values. Thus control unit of a computer is a finite state system.

26.	**Construct DFA over ∑=(a,b) which produces not more than 3a's.**	**APPLY BT - L3**	**CO1**	**PI 3.2.1**

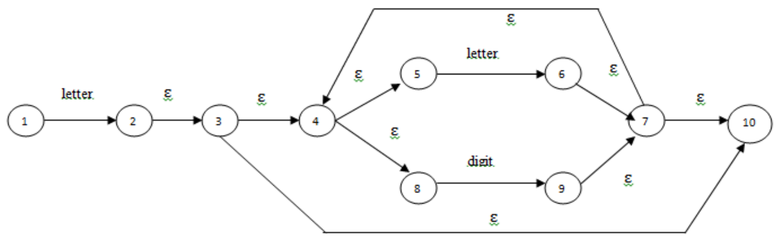


PART – B

1.	Prove that for every L recognized by an NFA, there exists an equivalent DFA accepting the same language L **(13)**	**(AU ND-2020)**	**UNDERSTAND BT - L2**	**CO1**	**PI 2.4.4**
2.	Prove that for every L recognized by an ∈-NFA, there exists an equivalent DFA accepting the same language L **(13)**	**(AU ND-2020)**	**UNDERSTAND BT - L2**	**CO1**	**PI 2.4.4**

<table>
<tr><td>3.</td><td>Construct a Deterministic Finite Automata equivalent to the NFA M=({p,q,r,s},{0,1}, δ p,{s}) where δ is given by (13)
<table>
<tr><td>δ</td><td>0</td><td>1</td></tr>
<tr><td>p</td><td>{p,q}</td><td>{p}</td></tr>
<tr><td>q</td><td>{r}</td><td>{r}</td></tr>
<tr><td>r</td><td>{s}</td><td>-</td></tr>
<tr><td>s</td><td>{s}</td><td>{s}</td></tr>
</table></td><td>(AU ND-2019)</td><td>APPLY
BT - L3</td><td>CO1</td><td>PI
3.2.1</td></tr>
<tr><td>4.</td><td>Give NFA accepting the set of strings in $(0+1)^*$ such that two 0's are separated by a string whose length is 4i, for some i>=0 (13)</td><td>(AU ND – 2019)</td><td>APPLY
BT - L3</td><td>CO1</td><td>PI
3.2.1</td></tr>
<tr><td>5.</td><td colspan="2">Convert the ε-NFA to DFA and list the difference between NFA and DFA (13)

</td><td>APPLY
BT - L3</td><td>CO1</td><td>PI
3.2.1</td></tr>
<tr><td>6.</td><td colspan="2">Prove that for every n>=1 by mathematical induction $\sum^{n} i^{3}$ = $\{n(n+1)/2\}^{2}$ (7)</td><td>UNDERSTAND
BT - L2</td><td>CO1</td><td>PI
2.1.3</td></tr>
<tr><td>7.</td><td colspan="2">(i) Given ∑= {a,b}, construct a DFA which recognize the languageL={b^{m} ab^{n}: m, n>0} (6)
(ii)Determine the DFA from a given NFA M=({q_0,q_1},{a,b},δ, q_0, {q_1}) with the state table diagram for δ given below. (7)
<table>
<tr><td>δ</td><td>a</td><td>b</td></tr>
<tr><td>q_0</td><td>$\{q_0, q_1\}$</td><td>$\{q_1\}$</td></tr>
<tr><td>q_1</td><td>$\emptyset$</td><td>$\{q_0, q_1\}$</td></tr>
</table></td><td>APPLY
BT - L3</td><td>CO1</td><td>PI
3.2.1</td></tr>
<tr><td>8.</td><td colspan="2">Discuss the basic approach to convert from NFA to Regular expression. Illustrate with an example. (13)</td><td>UNDERSTAND
BT - L2</td><td>CO1</td><td>PI
3.2.1</td></tr>
<tr><td>9.</td><td colspan="2">Prove that if x>=4 then 2^{x} >= x^{2} (7)</td><td>UNDERSTAND
BT - L2</td><td>CO1</td><td>PI
2.1.3</td></tr>
<tr><td>10.</td><td colspan="2">Prove that every tree has 'e' edges and 'e+1' nodes. (6)</td><td>UNDERSTAND
BT - L2</td><td>CO1</td><td>PI
2.1.3</td></tr>
<tr><td>11.</td><td colspan="2">Prove the equivalence of NFA and DFA using subset construction. (7)</td><td>UNDERSTAND
BT - L2</td><td>CO1</td><td>PI
3.2.1</td></tr>
<tr><td>12.</td><td colspan="2">Convert the following NFA to a DFA. (13)
<table>
<tr><td>δ</td><td>a</td><td>b</td></tr>
<tr><td>→p</td><td>{p}</td><td>{p,q}</td></tr>
<tr><td>q</td><td>{r}</td><td>{r}</td></tr>
<tr><td>r*</td><td>Φ</td><td>φ</td></tr>
</table></td><td>APPLY
BT - L3</td><td>CO1</td><td>PI
3.2.1</td></tr>
<tr><td>13.</td><td colspan="2">Prove the equivalence of NFA with ε and NFA without ε transition. (7)</td><td>UNDERSTAND
BT - L2</td><td>CO1</td><td>PI
3.2.1</td></tr>
</table>

14.	Prove that for every integer n>=0 the number $4^{2n+1}+3^{n+2}$ is a multiple of 3. **(7)**	**UNDERSTAND BT - L2**	**CO1**	**PI 2.1.3**
15.	(i) Prove the following by the principle of induction **(7)** $$\sum_{k=1}^{n} k^2=\frac{n(n+1)(2n+1)}{6}.$$ (ii) Construct a DFA that accepts all strings on {0,1} containing the substring 101. **(6)**	**UNDERSTAND BT - L2**	**CO1**	**PI 2.1.3**
16.	(i) Construct a non-deterministic finite automaton accepting the set of strings over {a,b} ending in aba. Use it to construct a DFA accepting the some set of strings. **(7)** (ii) Construct NFA with ε-moves which accepts a language consisting the strings of any number of a's, followed by any number c's. **(6)**	**APPLY BT - L3**	**CO1**	**PI 3.2.1**
17.	Consider the following ε-NFA for an identifier. Consider the letter ε-closure of each state and find it's equivalent Deterministic Finite Automata. **(13)**	**APPLY BT - L3**	**CO1**	**PI 3.2.1**



UNIT II

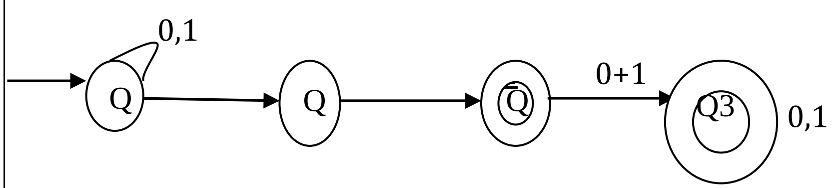
REGULAR EXPRESSIONS & LANGUAGES

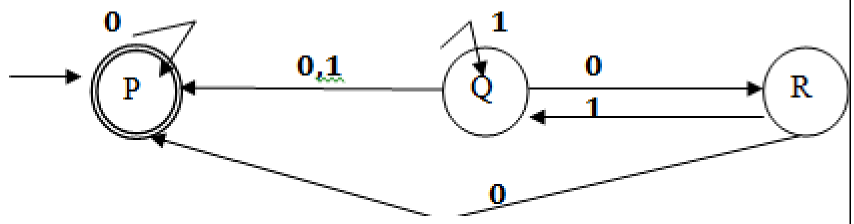
PART – A

1.	**Write the regular expression for all strings that contain no more than one occurrence of aa.**	**(AU – ND 2020)**	**APPLY BT - L3**	**CO1**	**PI 3.2.1**
	Regular expression: When aa in first position : aa (ba|bb|b)* When aa in middle position: (ab|bb|b)*aa(ba|bb|b)* When aa in last position:(ab|bb|b)*aa The final output is: aa(ba|bb|b)* + (ab|bb|b)*aa(ba|bb|b)* + (ab|bb|b)*aa				
2.	**Write a regular expression for even number of a's and even number of b's of a string w = {a, b}***	**(AU – ND 2020)**	**APPLY BT - L3**	**CO1**	**PI 3.2.1**
	Regular Expression: Even Number of a's: (aa)* Even Number of b's: (bb)* The final output is: (aa)*(bb)*				

	• Union is commutative • Union is idempotent			
26.	**What is a bad pair?**	**REMEMBER** **BT - L1**	**CO1**	**PI** **1.4.1**
	A pair (p,q) is called as a bad pair if • States p and q are distinguishable such that there is some string w where one of δ(p,w) and δ(q,w) is accepting.The table filling algorithm does not find p and q to be distinguished.			

PART – B

1.	Prove that the following languages are not regular using pumping lemma. i) All unary strings of length prime. **(7)** ii) L = {uu|u∈{0, 1}*}. **(6)**	**(AU ND – 2020)**	**UNDERSTAND** **BT - L2**	**CO1**	**PI** **2.4.4**
2.	State and Prove any two closure properties of Regular Languages (13)	**(AU ND – 2020)**	**REMEMBER** **BT - L1**	**CO1**	**PI** **2.4.4**
3.	(i).Prove that any language accepted by a Deterministic Finite Automata can be represented by a regular expression **(7)** (ii). Construct a FA for the regular expression 10 + (0+11)0*1. **(6)**	**(AU ND – 2019)**	**UNDERSTAND** **BT - L2**	**CO1**	**PI** **2.4.4**
4.	Prove that the following languages are not regular: (i). $\{w \in \{a,b\}^* \mid w=w^R\}$ **(7)** (ii). Set of strings of 0's and 1's beginning with a 1 whose value treated as a binary number is a prime. **(6)**	**(AU ND -2019)**	**UNDERSTAND** **BT - L2**	**CO1**	**PI** **2.4.4**
5.	Show that the regular language are closed under: **(13)** a. Union b. Intersection c. Kleene Closure d. Difference		**UNDERSTAND** **BT - L2**	**CO1**	**PI** **2.4.4**
6.	Design a finite automaton for the regular expression (0+1)*(00+11)(0+1*) **(13)**		**APPLY** **BT - L3**	**CO1**	**PI** **3.2.1**
7.	Prove that the class of regular sets is closed under complementation. **(7)**		**UNDERSTAND** **BT - L2**	**CO1**	**PI** **2.4.4**
8.	Convert the following NFA into regular expression. **(13)** 		**APPLY** **BT - L3**	**CO1**	**PI** **3.2.1**
9.	State the pumping lemma for Regular languages. S.T the set $L=\{0^{i^2} \mid i \geq 1\}$ is not regular **(7)**		**REMEMBER** **BT - L1**	**CO1**	**PI** **2.4.4**
10.	Prove that $L=\{0^{2n}\} n>=1\}$ is not regular **(6)**		**UNDERSTAND** **BT - L2**	**CO1**	**PI** **2.4.4**

11.	Give DFA accepting the following languages over the alphabet {0,1}, the set of all strings ending in 00 and minimize the Deterministic Finite Automata. **(13)**	**UNDERSTAND BT - L2**	**CO1**	**PI 3.2.1**
12.	Let r be a regular expression. Then prove that there exists an NFA with ε-transitions that accepts L(r). **(13)**	**UNDERSTAND BT - L2**	**CO1**	**PI 2.4.4**
13.	Construct an NFA equivalent to the regular expression ((0+1)(0+1)(0+1))* **(13)**	**APPLY BT - L3**	**CO1**	**PI 3.2.1**
14.	Show that $(r^*)^* = r^*$ for a regular expression **(6)**	**UNDERSTAND BT - L2**	**CO1**	**PI 2.4.4**
15.	S.T the set L= 0^{n2}| n is an integer and n>=1 is not regular language **(7)**	**UNDERSTAND BT - L2**	**CO1**	**PI 2.4.4**
16.	Construct a regular expression corresponding to the state diagram **(13)** 	**APPLY BT - L3**	**CO1**	**PI 3.2.1**
17.	Describe Arden's theorem with an example **(7)**	**UNDERSTAND BT - L2**	**CO1**	**PI 2.2.3**

PART – C

1.	Construct NFA with epsilon for the RE=$(a\|b)^*ab$ and convert into DFA and further find the minimized DFA **(15)**	**APPLY BT - L3**	**CO1**	**PI 3.2.1**
2.	Construct a minimized DFA for the regular expression(0+1)* (00+11)(0+1)* **(15)**	**APPLY BT - L3**	**CO1**	**PI 3.2.1**

UNIT III
CONTEXT FREE GRAMMAR AND LANGUAGES
PART – A

1.	**Write a Context Free Grammar for the language consisting of equal number of a's and b's**	**(AU ND – 2020)**	**APPLY BT - L3**	**CO2**	**PI 3.2.1**
	First possibility, S→01 | 10 If length >1 then S→0S1 | 1S0 Therefore, Context Free Grammar for the language consisting of equal number of a's and b's S→01 | 10 | 0S1 | 1S0				
2.	**Define Deterministic PDA**	**(AU ND – 2020)**	**REMEMBER BT - L1**	**CO2**	**PI 1.4.1**
	A PDA M =(Q, Σ ,Ґ ,δ ,q_0 ,Z_0 ,F) is deterministic if: • For each q in Q and Z in Ґ , whenever δ(q,Є,Z) is nonempty then δ(q,a,Z) is empty for all a in Σ.				

- For no q in Q , Z in Γ , and a in Σ U { Є} does δ(q,a,Z) contains more than one element.

Ex: The PDA accepting {wcw R | w in (0+1) * }.

3.	**When do you say a grammar is ambiguous?**	**(AU ND – 2019)**	**UNDERSTAND BT - L2**	**CO2**	**PI 1.4.1**

A grammar is said to be ambiguous when a same input string is derived from more than one parse trees or derivations.

A CFG G=(V,T,P,S) is ambiguous if there is atleast one string w in T* is having two different parse trees ,each with the same root S and same yield w.

4.	**Give a formal definition of Push Down Automata?**	**(AU ND – 2019)**	**REMEMBER BT - L1**	**CO2**	**PI 1.4.1**

A PDA can be formally described as a 7-tuple (Q, ∑, S, δ, q_0, I, F) –

- Q is the finite number of states
- ∑ is input alphabet
- S is stack symbols
- δ is the transition function: Q × (∑ ∪ {ε}) × S × Q × S*
- q_0 is the initial state (q_0 ∈ Q)
- I is the initial stack top symbol (I ∈ S)
- F is a set of accepting states (F ∈ Q)

5.	**What is meant by Context Free Grammar(CFG)?**	**REMEMBER BT - L1**	**CO2**	**PI 1.4.1**

Context Free Grammar is a grammar which have four components such as G=(V,T,P,S)

- A finite set of variables ‘V’ also called as non terminals
- A finite set of symbols called terminals T.
- S ⊆V is the start symbol or variable.
- A finite set of productions (P) or rules which is of the form

  A —> α, Where A – variable

  α – string of zero or more terminals and strings

6.	**Derive a string ‘aababa’ for the following Context Free Grammar (CFG) S→aSX|b; X→Xb|a**	**APPLY BT - L3**	**CO2**	**PI 3.2.1**

S =>aSX
=>aaSXX [S→aSX]
=>aabXX [S→b]
=>aabXbX [X→Xb]
=>aababX [X→a]
=>aababa [X→a]

Thus the given string is derived from the above grammar.

7.	**Generate CFG for a signed integer constant in C language**	**APPLY BT - L3**	**CO2**	**PI 3.2.1**

The CFG for a signed integer constant in C language as follows,

C→ 0 | S1N1
S1→ + | -
N1→ D1D2
D1→ 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
D2→ 0 | ε

- If L = N(M1) for some PDA M1 ,then L = L(M2) for some PDA M2
  where L(M) = language accepted by PDA by reaching a final state.
  N(M) = language accepted by PDA by empty stack.

26.	**Construct a PDA that accepts the language generated by the grammar. S → aABB, A → aB | a, B → bA | b**	**APPLY BT - L3**	**CO2**	**PI 3.2.1**

The PDA is given by

A = ({q}, {a,b}, {S, A, B, Z, a, b}, δ, q, S}

where δ : δ(q, z, S) = {(q, aABB)}

δ(q, z, A) = {(q, aB), (q, a)}

δ(q, z, B) = {(q, bA), (q, b)}

δ(q, a, a) = {(q, ε)}

δ(q, b, b) = {(q, ε)}

27.	**Is PDA superior over NFA in the sense of language acceptance? Justify your answer.**	**REMEMBER BT - L1**	**CO2**	**PI 1.4.1**

PDA is superior to NFA by having the following additional features.

- Stack which is used to store the necessary tape symbols and use the state to remember the conditions.
- Two ways of language acceptances, one by reaching its final state and another by emptying its stack.

28.	**Relate Context free language and DPDA**	**UNDERSTAND BT - L2**	**CO2**	**PI 1.4.1**

The languages accepted by the deterministic PDA by final state are properly included in the context free language,

- Each context free languages accepted by the DPDA have unambiguous grammar
- The DPDA languages are not exactly equal to the subset of the CFL that are not inherently ambiguous languages
- So if L=N(P) for some DPDA P, then L has an unambiguous CFG

PART – B

1.	How ∈-productions are eliminated from a grammar whose language doesn't have empty string ? Remove ∈-productions from the grammar given below. **(13)** S → a|aA|B|C A → aB| ∈ B → Aa C → aCD D → ddd	**(AU ND – 2020)**	**APPLY BT - L3**	**CO2**	**PI 3.2.1**
2.	Write procedure to find PDA to CFG. Give an example for PDA and its CFG **(13)**	**(AU ND – 2020)**	**UNDERSTAND BT - L2**	**CO2**	**PI 3.2.1**
3.	Suppose L=L(G) for some CFG G=(V,T,P,S) then prove that L-{∈} is L(G') for a CFG G' with no useless symbols or ∈-production **(13)**	**(AU ND – 2019)**	**UNDERSTAND BT - L2**	**CO2**	**PI 2.3.1**
4.	Prove that the languages accepted by Push Down Automata using empty stack and final states are equivalent **(13)**	**(AU ND – 2019)**	**UNDERSTAND BT - L2**	**CO2**	**PI 2.3.1**
5.	(i). Find PDA that accept the given CFG: S→xaax, X→ax|bx|ε **(7)** (ii). Construct PDA for the language $a^nb^ma^{n+m}$ **(6)**		**APPLY BT - L3**	**CO2**	**PI 3.2.1**
6.	(i). Prove that deterministic and non deterministic PDA		**UNDERSTAND**	**CO2**	**PI**

	are not equivalent **(7)** (ii). Explain pumping lemma for CFL **(6)**	**BT - L2**		**2.3.1**
7.	(i). Construct a DPDA for even length palindrome. **(7)** (ii). Prove – if PDA P is constructed from CFG G then N(P) =L(G) **(6)**	**APPLY** **BT - L3**	**CO2**	**PI** **2.3.1**
8.	Convert the following CFG to PDA and verify for (a+b) and a++ **(13)** I→a|b|Ia|Ib|I0|I1 E→I | E+E | E* E|(E)	**APPLY** **BT - L3**	**CO2**	**PI** **3.2.1**
9.	Outline an instantaneous description of a PDA. **(6)**	**REMEMBER** **BT - L1**	**CO2**	**PI** **2.1.2**
10.	With an example, explain the procedure to obtain a PDA from the given CFG **(13)**	**UNDERSTAND** **BT - L2**	**CO2**	**PI** **2.1.2**
11.	Design a PDA to accept $\{0^n1^n \mid n>1\}$. Draw the transition diagram for the PDA. Show by instantaneous description that the PDA accepts the string '0011' **(13)**	**APPLY** **BT - L3**	**CO2**	**PI** **3.2.1**
12.	(i).Convert PDA to CFG. PDA is given by P=({p,q},{0,1},{X,Z},δ,q,Z), δ is defined by δ(p,1,Z)=(p,XZ)}, δ(p, ε,z)={(P, ε)}, δ(p, 1,x)={(p,XX)}, δ(q,1,X)={(q, ε)}, δ(p,0,X)={(q,X)}, δ(q,0,Z)={(p,Z)} **(8)** (ii).What are DPDA? Give example for Non-deterministic and deterministic PDA. **(5)**	**APPLY** **BT - L3**	**CO2**	**PI** **3.2.1**
13.	Construct a pushdown automata to accept the language $L=\{a^nb^n/n\geq1\}$ by empty stack and by final state. **(8)**	**APPLY** **BT - L3**	**CO2**	**PI** **3.2.1**
14.	Prove that if L is N(M1)(Language accepted by empty stack) for some PDA M1,then L is N(M2)(Language accepted by final state) for some PDA. **(13)**	**UNDERSTAND** **BT - L2**	**CO2**	**PI** **2.1.2**
15.	Constrcut Push Down Automata for the language $L=\{ww^R \mid w \text{ in } (a+b)^*\}$. **(13)**	**APPLY** **BT - L3**	**CO2**	**PI** **3.2.1**
16.	Explain in detail about equivalence of pushdown automata. **(8)**	**REMEMBER** **BT - L1**	**CO2**	**PI** **2.1.2**
17.	Give formal pushdown automata that accepts $\{\omega c\omega^R \mid \omega$ is in $(0+1)^*\}$ by empty stack **(13)**	**APPLY** **BT - L3**	**CO2**	**PI** **3.2.1**

PART – C

1.	How PDA is converted into CFG ? Convert the following PDA into CFG. **(15)** P = ({p, q}, {0, 1}, {Z, X}, δ, p, Z, Φ) δ (p, 1, Z) = {(p, XZ)}, δ (p, ∈, Z) = {(p,∈)} δ (p, 1, X) = {(p, XX)}, δ (q, 1, X) = {(q, ∈)}, δ (p, 0, X) = {(q, X)}, δ (q, 0, Z) = {(p, Z)}	**(AU ND – 2020)**	**APPLY** **BT - L3**	**CO2**	**PI** **3.2.1**
2.	(i). Suppose L= N(M) for some PDA M, then prove that L is a CFL **(7)** (ii). Give a CFG for the language N(M) where M= $(\{q_0,q_1\},\{0,1\},\{Z_0,X\},\delta,q_0,Z_0,q1)$ and δ is given by,	**(AU ND – 2019)**	**APPLY** **BT - L3**	**CO2**	**PI** **2.1.2**

	$\delta(q_0,1,Z_0) = \{(q_0, XZ_0)\}$ $\delta(q_0, \varepsilon,Z_0)= \{(q_0, \varepsilon)\}$ $\delta(q_0,1,X)=\{(q_0,XX)\}$ $\delta(q_1,1,X)= \{(q_1, \varepsilon)\}$ $\delta(q_0,0,X)=\{(q_1,X)\}$ $\delta(q_1,0,Z_0)=\{(q_0,Z_0)\}$ **(8)**			
3.	(i).Construct the PDA accepting the language $\{(ab)^n \mid n\geq1\}$ by empty stack. **(7)** (ii).Constrcut a transition table for PDA which accepts the language $L=\{a^{2n}b^n \mid n\geq1\}$.Trace your PDA for the input with n=3. **(8)**	**APPLY BT - L3**	**CO2**	**PI 3.2.1**
4.	Let $M=(\{q_0,q_1\},\{0,1\},\{x,z_0\},\delta,q_0,z_0,q1)$ where δ is given by $\delta(q_0,0,z_0)=\{(q_0,xz_0)\}$, $\delta(q_1,1,x)=\{(q_1,\varepsilon)\}$, $\delta(q_0,0,x)=\{(q_0,xx)\}$, $\delta(q_1,\varepsilon,x)=\{(q_1,\varepsilon)\}$ $\delta(q_1,\varepsilon,z_0)=\{(q_1,\varepsilon)\}$ Construct a CFG for the PDA. **(15)**	**APPLY BT - L3**	**CO2**	**PI 3.2.1**

UNIT IV

PROPERTIES OF CONTEXT FREE LANGUAGES

PART – A

1.	**What are the two normal forms of CFG ? Write their productions format.**	**(AU ND-2020)**	**REMEMBER BT - L1**	**CO2**	**PI 1.4.1**

The two normal forms of CFG are,

- Chomsky Normal Form (CNF)
  - General Format of CNF is A→BC | a
- Greibach Normal Form (GNF)
  - General Format of GNF is A→aα

2.	**Define the language recognized by any Turing Machine.**	**(AU ND-2020 / 2019)**	**REMEMBER BT -L1**	**CO3**	**PI 1.4.1**

The language recognized by a Turing machine is, by definition, the set of strings it accepts. When an input is given to the machine, it is either accepted or not. Any particular input to that machine is either always accepted (in the language) or always not accepted (not in the language).

3.	**What are the advantages of having a normal form for a grammar?**	**(AU ND – 2019)**	**REMEMBER BT - L1**	**CO2**	**PI 1.4.1**

There are two advantages of having a normal form for a grammar

- **Simplicity of proofs** - There are plenty of proofs around context-free grammars, including reducibility and equivalence to automata. Those are the simpler the more restricted the set of grammars
- **Enables parsing** - Normal forms can give us more structure to work with, resulting in easier parsing algorithms.

4.	**What are the closure properties of context free languages?**	**REMEMBER BT - L1**	**CO2**	**PI 1.4.1**

The closure properties of CFL are

- Context free languages are closed under union.
- Context free languages are closed under concatenation.
- Context free languages are closed under kleene closure.
- Context free languages are not closed under intersection.

5.	**Write down the theorem for pumping lemma for CFL**	**REMEMBER BT - L1**	**CO2**	**PI 1.4.1**

Let 'L' be a CFL. Then there exists a constant 'n' such that if Z is any string in 'L' such that |Z| is atleast n, then we can write Z=uvwxy with the following condition,

i. $|vwx| \leq n$
ii. $vx \neq \varepsilon$
iii. for all $i \geq 0$, uv^iwx^iy is in L

6.	**Show that L={a^p | p is prime} is not context free**	**UNDERSTAND BT- L2**	**CO2**	**PI 2.4.4**

To prove the given language is not context free, the steps are as follows,

- Choose the pumping length of *p*.
- Consider some prime $n \geq p+2$.
- Such an *n* must exist since there are an infinite number of primes.
- Let $s= 1^n$,
- The string is broken into *uvxyz.*
- Let $|vy| = m$.
- Then, $|uxz| = n-m$.
- By the pumping lemma, $uv^{n-m}xy^{n-m}z \in L$
- $/uv^{n-m}xy^{n-m}z/ = /uxz/ + (n-m)\times(/v/ + /y/) = n-m + (n-m)\ m = (n-m)\ (m+1)$
    - Thus, $/uv^{n-m}xy^{n-m}z/$ is not prime unless one of the above factors is 1. So that the given language is not context free.

7.	**Define Turing Machine**	**REMEMBER BT - L1**	**CO3**	**PI 1.4.1**

Turing machines are an abstract model of computation. They provide a precise, formal definition of what it means for a function to be computable. The key features of the Turing machine model of computation are:

- A finite amount of internal state.
- An infinite amount of external data storage.
- A program specified by a finite number of instructions in a predefined language.
- Self-reference: the programming language is expressive enough to write an interpreter for its own programs

8.	**Give the configuration of Turing Machine**	**REMEMBER BT - L1**	**CO3**	**PI 1.4.1**

The configuration of Turing machine is a collection of 7 tuples
M=(Q,∑,Γ,δ,q0,Δ,orB,F)

- Q is a finite set of states.
- r is a finite set of external symbols.
- ∑ is a finite set of input symbols.
- Δ or B is a blank symbol used as an end marker for input.
- δ is a transition function.
    - Ex:δ(q0,a)->(q,A,L)
    - Reading the input symbol 'a', transition made from q0 state to q1 by printing (replacing) 'a' by 'A' and move ahead to left.
- q0 be the start state q0∈Q.
- F is a set of final state, where the turing machine halts.

27.	**What are useless symbol in a grammar?**	**REMEMBER BT - L1**	**CO2**	**PI 1.4.1**
	For any symbol if there is no derivation to generate a terminal string then that symbol is called useless symbol. All the useless symbols from the production rule must be identified and removed to produce the reduced grammar.			
28.	**Define simplification of CFG.**	**REMEMBER BT - L1**	**CO2**	**PI 1.4.1**
	Elimination of null and unit productions and symbols is called simplification of CFG. The result of simplified context free grammar is known as reduced grammar. The reduction of context free grammar can be carried out in three ways . • Removal of useless symbols • Elimination of ε-productions • Removal of unit productions.			

PART – B

1.	How a CFG for L is converted into CNF accepting the same language ? Convert the following CFG into CFG in CNF. **(13)** S -> b A | a B A -> b A A | a S | a B → a B B | b S | b	**(AU ND – 2020)**	**UNDERSTAND BT - L2**	**CO2**	**PI 2.2.3**
2.	Construct a Turing Machine for proper subtraction, which is defined as m – n if m > n and 0 otherwise. **(13)**	**(AU ND – 2020)**	**UNDERSTAND BT - L2**	**CO4**	**PI 2.2.3**
3.	State and prove GNF **(13)**	**(AU ND – 2019)**	**UNDERSTAND BT - L2**	**CO2**	**PI 2.4.4**
4.	Design a TM to compute proper subtraction **(13)**	**(AU ND – 2019)**	**APPLY BT - L3**	**CO4**	**PI 2.2.3**
5.	Consider two tape TM and determine whether the TM always writes a nonblank symbol on its second tape during the computation on any input string 'w'. Formulate this problem as a language and show it is undecidable. **(13)**		**APPLY BT - L3**	**CO4**	**PI 2.2.3**
6.	Construct TM that replace all occurrence of 111 by 101 from sequence of 0's and 1's. **(13)**		**APPLY BT - L3**	**CO4**	**PI 2.2.3**
7.	(i). Explain techniques for TM Construction **(7)** (ii). Illustrate the Chomsky grammar classification with necessary example **(6)**		**REMEMBER BT - L1**	**CO3**	**PI 2.2.3**
8.	Construct a TM to reverse the given string. **(13)**		**APPLY BT - L3**	**CO4**	**PI 2.2.3**
9.	Design a Turing machine to accept language L={0^n1^n/n>=1} and simulate its action on the input 0011. **(13)**		**APPLY BT - L3**	**CO4**	**PI 2.2.3**
10.	Explain Turing machine as a computer of integer functions with an example. **(7)**		**REMEMBER BT - L1**	**CO4**	**PI 2.2.3**
11.	i.Design a Turing Machine to recognize {ww^R | w ?		**APPLY**	**CO4**	**PI**

	(0 + 1)*} . **(7)** ii. Design TM M for f(x,y)=x*y where x,y are stored in the tape in the form 0^x10^y1. **(6)**	**BT - L3**		**2.2.3**
12.	Show that the language L={$a^ib^ic^i$/i>=1} is not context free. **(7)**	**REMEMBER BT - L1**	**CO2**	**PI 2.4.4**
13.	Obtain a grammar in Chomsky Normal Form (CFG) equivalent to the grammar G with the productions P given. **(13)** S→ $aAbB$, A→ $aA\|a$, B→ $bB\|b$	**APPLY BT - L3**	**CO2**	**PI 2.2.3**
14.	Construct a equivalent grammar G in CNF for the grammar G1 where G1=({S,A,B},{a,b},{S→ASB| **ε**, A→aAS|a,B→SbS|A|bb},S). **(13)**	**APPLY BT - L3**	**CO2**	**PI 2.2.3**
15.	Convert the following grammar into GNF. **(13)** S→>XY1|0, X→00X|Y, Y→1X1	**APPLY BT - L3**	**CO2**	**PI 2.2.3**
16.	Convert the following grammar into an equivalent one with no unit productions and no useless symbols S-> ABA, A->aAA|aBc|bB,B-> A | bB | Cb,C->CC | cC **(13)**	**APPLY BT - L3**	**CO2**	**PI 2.2.3**

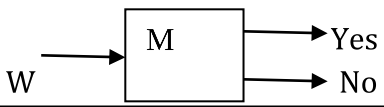
PART – C

1.	Construct a Turing Machine for multiplying two non negative integers using subroutine **(15)**	**(AU ND – 2020)**	**APPLY BT - L3**	**CO2**	**PI 2.2.3**
2.	(i).Design a TM to compute multiplication of two positive integers **(8)** (ii).Design a TM to recognize the language {$0^n1^n0^n$ | n>=1} **(7)**	**(AU ND – 2019)**	**APPLY BT - L3**	**CO4**	**PI 3.2.1**
3.	Design a Turing machine to accept language L={a^nb^n/n>=1} and simulate its action on the input n=3. **(15)**		**APPLY BT - L3**	**CO3**	**PI 3.2.1**

UNIT V

UNDECIDABILITY

PART – A

1.	**What are recursive language?**	**(AU ND – 2020)**	**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
	A language is recursive if there exists a Turing Machine that accepts every string of the language and rejects the string that is not in the language. 				
2.	**Define the classes P and NP problem. Give example problems for both**	**(AU ND – 2020)**	**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
	• Class P: The problem solvable in polynomial time on a typical computer are exactly the same as the problems solvable in polynomial time on a Turing machine. Ex: Kruskal's Algorithm • Class NP: The problems which cannot be solvable in polynomial time are called intractable problem.				

Example for NP-complete problems are,

- 0/1 Knapsack problem.
- Hamiltonian cycle.
- Travelling salesman problem.

3.	**When do you say a Turing machine is an algorithm?**	**(AU ND – 2019)**	**UNDERSTAND BT - L2**	**CO5**	**PI 1.4.1**
	A Turing machine is a mathematical model of computation that defines an abstract machine, which manipulates symbols on a strip of tape according to a table of rules. Despite the model's simplicity, given any computer algorithm, a Turing machine capable of simulating that algorithm's logic can be constructed.				
4.	**Define NP – Class**	**(AU ND – 2019)**	**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
	Class NP problems are problems which are non-deterministic problems solved in polynomial time. Example: TSP problem.				
5.	**List the properties of recursive and recursive enumerable language.**		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
	The properties of recursive and Recursively Enumerable Language • The complement of a Recursive language is Recursive. • The union of two recursive languages is recursive. The union of two Recursively Enumerable languages is RE. • If a language L and complement L are both RE, then L is recursive.				
6.	**Write short notes on tractable problem**		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
	The problems which are solvable by polynomial time algorithms are called tractable problems. For example: The complexity of the Kruskal's algorithm is 0(e(e+m)) where e, the number of edges and m ,the number of nodes.				
7.	**What is primitive recursive function?**		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
	The set PR of primitive recursive function is defined as follows: • All initial function are elements of PR. For any k>=0 and m>=0 , if $f:N^m \rightarrow N$ and $g_1,g_2,....g_k:N^m \rightarrow N$ are elements of PR, then the function $f(g_1,g_2,.......g_k)$ obtained from f and $g_1,g_2........g_k$ by composition is an element of PR.				
8.	**Define NP Completeness**		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
	A language L is NP- complete if the following statements are true • L is in NP • For every language L' in NP there is a polynomial – time reduction of L' to L.				
9.	**Define NP-hard and NP-completeness problem**.		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
	• **NP Hard:** if a problem A is reducible to B, then it means that B is at least as hard as A. The problem A is not solved in polynomial time T. • **NP-Complete:**The group of problems which are both in NP and NP-hard are known as NP-Complete problem.				

25.	**Define CNF satisfiability problem**	**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
	The CNF Satisfiability Problem (CNF-SAT) is a version of the Satisfiability Problem, where the Boolean formula f(x1, x2, . . . , xn), is specified in the Conjunctive Normal Form (CNF), that means that it is a conjunction of clauses, where a clause is a disjunction of literals, and a literal is a variable or its negation.			
26.	**What is the measuring complexity for NFA?**	**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
	Time Complexity for NFA: Let T be a non-deterministic TM t, which accepts language L over alphabet ∑.The time complexity $T_t(n)$ is the minimum number of moves t can make an any input string of length n. **Space Complexity for NFA:** Space complexity of a non-deterministic TM $S_t(n)$ is the minimum number of tape squares used by TM for any input string of length n.			

PART – B

1.	Prove that Universal language is recursively enumerable but not recursive. **(13)**	**(AU ND – 2020)**	**UNDERSTAND BT - L2**	**CO5**	**PI 1.4.1**
2.	Define PCP and prove that PCP is undecidable **(13)**	**(AU ND – 2020)**	**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
3.	Prove that Post Correspondence Problem is undecidable **(13)**	**(AU ND – 2019)**	**UNDERSTAND BT - L2**	**CO5**	**PI 1.4.1**
4.	Prove that the L_u is recursively enumerable but not recursive **(13)**	**(AU ND – 2019)**	**UNDERSTAND BT - L2**	**CO5**	**PI 1.4.1**
5.	Explain universal Turing machine **(13)**		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
6.	Explain how to measure and classify complexity. **(13)**		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
7.	Explain recursive and recursively enumerable languages with example **(13)**		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
8.	Explain tractable and intractable problem with suitable example **(13)**		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
9.	Elaborate on primitive recursive functions with an example **(8)**		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
10.	Outline the concept of polynomial time reductions. **(6)**		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
11.	Prove that “MPCP reduces to PCP” **(7)**		**UNDERSTAND BT - L2**	**CO5**	**PI 1.4.1**
12.	State and explain RICE theorem **(7)**		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
13.	Show that union of two recursive language is recursive and union of two RE language is recursive. **(6)**		**UNDERSTAND BT - L2**	**CO5**	**PI 1.4.1**
14.	Explain about “A language that is not Recursively Enumerable”. **(6)**		**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
15.	Prove L_{ne} is recursively enumerable. **(7)**		**UNDERSTAND BT - L2**	**CO5**	**PI 1.4.1**

16.	Prove that if a language is recursive iff it & its complement are both RE **(7)**	**UNDERSTAND BT - L2**	**CO5**	**PI 1.4.1**
17.	Explain about undecidability of PCP. **(6)**	**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
18.	Define PCP.Let ∑{0,1}.Let A and B be the lists of three strings each defined as, Wi=A={1,10111,10}, Xi=B={111,10,0},Does this PCP have a solution? **(6)**	**REMEMBER BT - L1**	**CO5**	**PI 1.4.1**
19.	Prove that the function f add (x,y)=x+y is a primitive recursive . **(7)**	**UNDERSTAND BT - L2**	**CO5**	**PI 1.4.1**

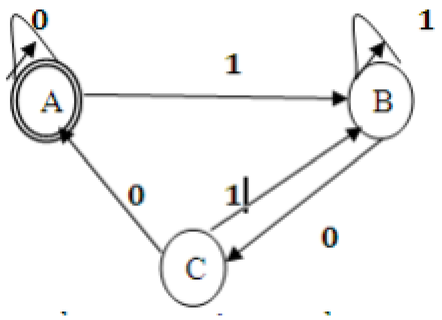
QUESTION PAPER CODE: 90159
B.E / B.Tech DEGREE EXAMINATIONS, NOV / DEC 2019
Fifth Semester
Computer Science and Engineering
CS8501 – Theory of Computation
(Regulation 2017)

Time : 3 Hrs **Maximum: 100 Marks**

Answer All questions

PART – A (10 * 2 = 20)

1. Prove by induction on n>=1 that ∑ 1/i(i+1) = n/ (n+1) i=1
2. Formally define Deterministic Finite Automata (DFA).
3. Construct regular expression corresponding to the state diagram



4. State the definition of pumping lemma for regular set.
5. When do you say a grammar is ambiguous?
6. Give a formal definition of Push Down Automata?
7. What are the advantages of having a normal form for a grammar?
8. Define the language recognized by the Turing Machine
9. When do you say a Turing machine is an algorithm?
10. Define NP – Class

PART – B

11. a) Construct a Deterministic Finite Automata equivalent to the NFA M=({p,q,r,s},{0,1}, δ p,{s}) where δ is given by (13)

δ	0	1
p	{p,q}	{p}
q	{r}	{r}
r	{s}	-
s	{s}	{s}

(OR)

b) Give NFA accepting the set of strings in (0+1)* such that two 0's are separated by a string whose length is 4i, for some i>=0

12. a).(i).Prove that any language accepted by a Deterministic Finite Automata can be represented by a regular expression (7)

(ii). Construct a FA for the regular expression 10 + (0+11)0*1. (6)

(OR)

b).Prove that the following languages are not regular: (i). {w ∈ {a,b}* | w=wR} (7) (ii). Set of strings of 0's and 1's beginning with a 1 whose value treated as a binary number is a prime. (6)

13. a) Suppose L=L(G) for some CFG G=(V,T,P,S) then prove that L-{∈} is L(G') for a CFG G' with no useless symbols or ∈-productions.

(OR)

b) Prove that the languages accepted by Push Down Automata using empty stack and final states are equivalent

14. a) State and prove Greibach Normal Form

(OR)

b) Design a TM to compute proper subtraction

15. a) Prove that Post Correspondence Problem is undecidable

(OR)

b) Prove that the Lu is recursively enumerable but not recursive

PART - C

17. a)(i). Suppose L= N(M) for some PDA M, then prove that L is a CFL (7)

(ii). Give a CFG for the language N(M) where M=({q0,q1},{0,1},{Z0,X},δ,q0,Z0,ϕ) and δ is given by, (8) δ (q0,1,Z0) = {(q0, XZ0)} δ(q0,Ɛ,Z0)= {(q0,Ɛ) } δ(q0,1,X)={(q0,XX)} δ(q1,1,X)= {(q1,Ɛ)} δ(q0,0,X)={(q1,X)} δ(q1,0,Z0)={(q0,Z0)}

(OR)

b)(i).Design a TM to compute multiplication of two positive integers (8)

(ii).Design a TM to recognize the language $\{0^n1^n0^n \mid n>=1\}$ (7)

QUESTION PAPER CODE: X10319

B.E./B.Tech. DegreeExaminationS, November/December2020

Fifth SemesterComputer Science and Engineering

CS 8501 – THEORY OF COMPUTATION

(Regulations 2017)

Time : Three Hours **Maximum : 100 Marks**

Answer all questions

Part– A (10×2 = 20 Marks)

1. Define Deterministic Finite Automaton.

2. State any four types of proofs.

3. Write the regular expression for all strings that contain no more than one occurrence of aa.

4. Write a regular expression for even number of a's and even number of b's of a string w = {a, b}*.

5. Write a Context Free Grammar for the language consisting of equal number of a's and b's.

6. Define Deterministic PDA.

7. What are the two normal forms of CFG? Write their productions format.

8. Define the language recognized by any Turing Machine.

9. What are recursive languages ?

10. Define the classes P and NP problem. Give example problems for both.

Part– B (5×13 = 65 Marks)

11. a) Prove that for every Lrecognized by an NFA, there exists an equivalent DFA accepting the same language L.

(OR)

b) Prove that for every Lrecognized by an ∈-NFA, there exists an equivalent DFA accepting the same language L.

12. a) Prove that the following languages are not regular using pumping lemma.

i) All unary strings of length prime. **(7)**

ii) L= {uu|u∈{0, 1}*}. **(6)**

(OR)

b) State and Prove any two closure properties of Regular Languages.

13. a) How ∈-productions are eliminated from a grammar whose language doesn't have empty string ? Remove ∈-productions from the grammar given below. S → a|aA|B|CA→ aB| ∈ B → Aa C→ aCD D → ddd

(OR)

b) Write procedure to find PDAto CFG. Give an example for PDAand its CFG.

14. a) How a CFGfor Lis converted into CNF accepting the same language ? Convert the following CFGinto CFGin CNF. S → b A| a B A→ b AA| a S | a B → a B B | b S | b

(OR)

b) Construct a Turing Machine for proper subtraction, which is defined as m – n if m > n and 0 otherwise.

15. a) Prove that Universal language is recursively enumerable but not recursive.

(OR)

b) Define PCP and prove that PCP is undecidable.

Part– C (1×15 = 15 Marks)

16. a) Construct a Turing Machine for multiplying two non negative integers using subroutine.

(OR)

b) How PDAis converted into CFG? Convert the following PDAinto CFG. P = ({p, q}, {0, 1}, {Z, X}, δ, p, Z, Φ) δ (p, 1, Z) = {(p, XZ)}, δ (p, ∈, Z) = {(p,∈)} δ (p, 1, X) = {(p, XX)}, δ (q, 1, X) = {(q, ∈)}, δ (p, 0, X) = {(q, X)}, δ (q, 0, Z) = {(p, Z)}

KINGS
COLLEGE OF ENGINEERING
Punalkulam, Thanjavur.
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

TÜV Rheinland CERT ISO 9001
ISO 9001 : 2008

Attendance and Assessment Record

Name of the Staff : S. PUVANESWARI

Department : CSE

Subject Code & Name : CS8501 - THEORY OF COMPUTATION

Branch : CSE

Semester : V

21 - 22 odd

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COLLEGE OF ENGINEERING
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Semester : V

21 - 22 odd

Attendance and Assessment Record

Name of the Staff : S. BUVANESWARI Dept CSE

Name of the Subject : THEORY OF COMPUTATION Code CS8501

Branch CSE

Semester V Year III

Date of Commencement : 18.08.2021 Last Working Day 20.1.2022

Details	Sessions Planned	Sessions Handled	% of Portions covered	Sign. of HOD
End of the First Month	6	6	15%	Sd/- 1/9/21
End of the Second Month	22	22	50%	Sd/- 1/10/21
End of the Third Month	35	35	78%	Sd/- 24/11/21
End of the Fourth Month	45 REVISION	45 3	100%	Sd/- 19/1

CBS 1

49.

J. [signature] 23/3/22

PRINCIPAL

Attendance Particulars

Roll No.	Name	Date	19	24	25	26	27	31	1	2	3	7
		Month	8	8	8	8	8	8	9	9	9	9
		Period	5	3	1	5	4	3	1	5	4	3
1	R. AARTHI		/	/	/	/	/	/	/	/	/	/
2	S. AIYAPPAN		/	A	A	/	/	/	/	/	/	/
3	G.S. AJAY PRASANNA		/	/	/	A	/	/	/	/	/	/
4	K. AKASH		/	/	/	/	/	A	/	/	/	/
5	G. AKSHAYALAKSHMI		/	/	/	/	/	/	/	/	/	/
6	A. ARAVIND		/	/	/	A	/	/	/	/	/	A
7	A.R. AVUDAIAPPAN		/	/	/	A	/	/	/	/	/	/
8	A. BAKIYA LAKSHMI		/	A	/	/	/	/	/	/	/	/
9	M. BALAKRISHNAN		/	/	/	A	/	/	/	/	/	/
10	S. BAVYA		/	/	/	/	/	/	A	/	/	/
11	T. BHAVATHARANI		/	/	/	/	/	/	/	/	/	/
12	P. DEEPIKA		/	/	/	/	/	/	/	/	/	/
13	S. DEVIPRIYA		/	/	/	/	/	/	/	/	/	/
14	G. DHARANI		/	/	/	/	/	/	/	/	/	/
15	J. DIVAKARAN		/	/	/	/	/	/	/	/	/	/
16	T. ELAYADHARSHINI		/	A	/	/	/	/	/	/	/	/
17	J. FASILA AFREEN		/	/	/	/	/	/	/	/	/	/
18	M. GOKUL		/	/	/	A	/	/	/	/	/	/
19	A. GOMATHI		/	/	/	/	/	/	/	/	A	/
20	P. GOPINATH		/	/	/	/	/	/	/	/	/	/
21	K. GOVINDHARAJAN		/	/	/	/	/	/	/	/	/	/
22	K. KAMALI		/	A	/	A	/	/	/	/	/	A
23	K. KANISHKAR		A	/	/	/	/	/	A	/	/	/
24	N. KARKUZHALI		/	/	/	/	/	/	/	/	/	/
25	R. KARTHIKA		A	/	/	/	/	/	A	/	/	/

Roll No.	8	9	14	15	16	17	23	24	28	29
	9	9	9	9	9	9	9	9	9	9
	1	3	3	1	5	4	1	4	3	1
1	/	/	/	/	/	/	/	/	/	/
2	/	/	/	/	/	/	/	/	/	/
3	/	/	/	/	/	/	/	/	/	/
4	/	/	/	/	A	/	A	/	/	/
5	/	/	/	/	/	/	/	/	/	/
6	/	/	A	/	/	/	A	/	/	/
7	/	/	A	/	/	/	A	/	/	/
8	/	/	/	/	/	/	/	/	/	/
9	/	/	A	/	/	/	A	/	/	/
10	/	/	/	/	/	/	/	/	/	/
11	/	/	/	/	/	/	/	/	/	/
12	/	/	/	/	/	/	/	/	/	/
13	/	/	/	/	/	/	/	/	/	/
14	/	/	/	/	/	A	/	/	/	A
15	/	/	/	/	/	/	/	A	/	/
16	/	/	/	/	/	/	/	/	/	/
17	/	A	/	/	/	/	/	/	/	/
18	/	/	/	/	/	/	/	/	/	/
19	/	/	/	A	/	/	/	/	/	/
20	/	/	/	A	/	/	/	/	/	/
21	/	/	/	/	/	A	/	/	A	/
22	/	/	/	/	/	/	/	/	/	/
23	/	/	/	A	/	/	/	/	/	/
24	/	/	/	/	/	/	/	/	/	/
25	/	/	/	/	A	/	/	/	/	/

Attendance Particular

Roll No.	Name
1	R. AARTHI
2	S. AIYAPPAN
3	G.S. AJAY PRASAN
4	K. AKASH
5	G. AKSHAYALAKSHI
6	A. ARAVIND
7	A.B. AVUDAIAPPAN
8	A. BAKIYA LAKSHM
9	M. BALAKRISHNAN
10	S. BAVYA
11	T. BHAVATHARANI
12	P. DEEPIKA
13	S. DEVIPRIYA
14	G. DHARANI
15	J. DIVAKARAN
16	T. ELAYADHARSHINI
17	J. FASILA AFREEN
18	M. GOKUL
19	A. GOMATHI
20	P. GOPINATH
21	K. GOVINDHARAJA
22	K. KAMALI
23	K. KANISHKAR
24	N. KARKUZHALI
25	R. KARTHIKA

Date / Mont / Peric

Roll No.	30	30	01	05	07	08	12	13	20	21
	9	9	10	10	10	10	10	10	10	10
	2	5	4	3	2	1	1	1	1	3
1	/	/	/	/	/	A	/	/	/	/
2	/	/	/	/	/	/	/	/	/	/
3	/	/	/	/	/	/	/	/	/	/
4	/	/	/	/	/	/	/	/	/	/
5	/	/	/	/	A	/	/	/	/	/
6	/	/	/	/	/	/	A	/	/	/
7	/	/	/	/	/	/	/	/	/	/
8	A	/	/	/	/	A	/	/	/	/
9	/	/	/	/	/	/	/	A	/	/
10	A	/	/	/	/	/	/	/	/	/
11	/	/	/	/	/	/	/	/	/	/
12	/	/	/	/	/	/	/	/	/	/
13	/	/	/	/	/	/	/	/	/	/
14	/	/	/	/	/	/	/	/	/	/
15	/	/	/	/	A	/	/	A	/	/
16	/	/	A	/	/	/	/	/	/	/
17	/	/	/	/	/	/	/	/	/	/
18	/	/	A	/	/	/	/	/	/	/
19	/	/	/	/	A	/	/	/	/	/
20	/	/	/	/	/	/	/	/	/	/
21	/	/	/	/	/	/	/	/	/	/
22	/	/	A	/	/	/	/	/	/	/
23	/	/	/	/	/	/	/	/	/	/
24	/	/	/	/	/	/	/	/	/	/
25	/	/	/	/	/	/	/	/	/	/

Roll No.	22	23	27	28	29	02	03	09	10	11
	10	10	10	10	10	11	11	11	11	11
	1	4	1	3	1	4	1	2	1	3
1	/	/	/	/	/	/	/	/	/	/
2	/	/	/	/	/	/	/	/	/	/
3	/	/	/	/	A	/	/	/	/	/
4	/	/	/	/	/	/	/	/	/	/
5	/	/	/	/	/	/	/	/	/	/
6	/	/	/	/	/	/	/	/	/	/
7	/	/	/	A	/	/	/	/	/	/
8	/	/	/	/	/	/	/	/	/	/
9	/	/	/	/	/	/	/	/	/	/
10	/	/	/	/	/	/	/	/	/	/
11	/	/	/	/	/	/	/	/	/	/
12	/	/	/	/	/	/	/	/	/	/
13	/	/	/	/	/	/	/	/	/	/
14	/	/	/	A	/	/	/	/	/	/
15	/	A	/	/	/	/	/	/	/	/
16	/	A	/	/	/	/	/	/	/	/
17	/	/	/	/	/	/	/	/	/	/
18	/	A	/	/	/	/	/	/	/	/
19	/	A	/	A	/	/	/	/	/	/
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23	/	/	A	/	/	/	/	/	/	/
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25	/	/	A	/	/	/	/	/	/	/

Attendance Particular

Roll No.	Name											
		Date	12	16	16	16	19	24	1	10		
		Mont	11	11	11	11	11	11	12	12		
		Peric	1	4	5&6	6	1	4&5	4&5	1-3		
1	R. AARTHI		/	/	/	/	/	/	/	/		
2	S. AIYAPPAN		/	/	/	/	/	/	/	/		
3	G.S. AJAY PRASAN		/	/	/	/	/	/	/	/		
4	K. AKASH		/	/	/	/	/	/	/	/		
5	G. AKSHAYALAKSHI		/	/	/	/	/	/	/	/		
6	A. ARAVIND		A	/	/	/	/	/	/	/		
7	A.B. AVUDAIAPPAN		/	/	/	/	/	/	/	/		
8	A. BAKIYA LAKSHM		/	/	/	/	/	/	/	/		
9	M. BALAKRISHNAN		/	/	/	/	/	/	/	/		
10	S. BAVYA		/	/	/	/	/	/	/	/		
11	T. BHAVATHARANI		/	/	/	/	/	/	/	/		
12	P. DEEPIKA		/	/	/	/	/	/	/	/		
13	S. DEVIPRIYA		/	/	/	/	/	/	/	/		
14	G. DHARANI		/	/	/	/	/	/	/	/		
15	J. DIVAKARAN		/	/	/	/	/	/	/	/		
16	T. ELAYADHARSHINI		/	/	/	/	/	/	/	/		
17	J. FASILA AFREEN		/	/	/	/	/	/	/	/		
18	M. GOKUL		/	/	/	/	/	/	/	/		
19	A. GOMATHI		/	/	/	/	/	/	/	/		
20	P. GOPINATH		/	/	/	/	/	/	/	/		
21	K. GOVINDHARAJA		/	/	/	/	/	/	/	/		
22	K. KAMALI		/	/	/	/	/	/	/	/		
23	K. KANISHKAR		/	/	/	/	/	/	/	/		
24	N. KARKUZHALI		/	/	/	/	/	/	/	/		
25	R. KARTHIKA		/	/	/	/	/	/	/	/		

Attendance Particular

Roll No.	Name	Date / Month / Period
1	R. AARTHI	
2	S. AIYAPPAN	
3	G.S. AJAY PRASAN	
4	K. AKASH	
5	G. AKSHAYALAKSHI	
6	A. ARAVIND	
7	A.B. AVUDAIAPPAN	
8	A. BAKIYA LAKSHM	
9	M. BALAKRISHNAN	
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12	P. DEEPIKA	
13	S. DEVIPRIYA	
14	G. DHARANI	
15	J. DIVAKARAN	
16	T. ELAYADHARSHINI	
17	J. FASILA AFREEN	
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19	A. GOMATHI	
20	P. GOPINATH	
21	K. GOVINDHARAJA	
22	K. KAMALI	
23	K. KANISHKAR	
24	N. KARKUZHALI	
25	R. KARTHIKA	

Roll No.										
1										
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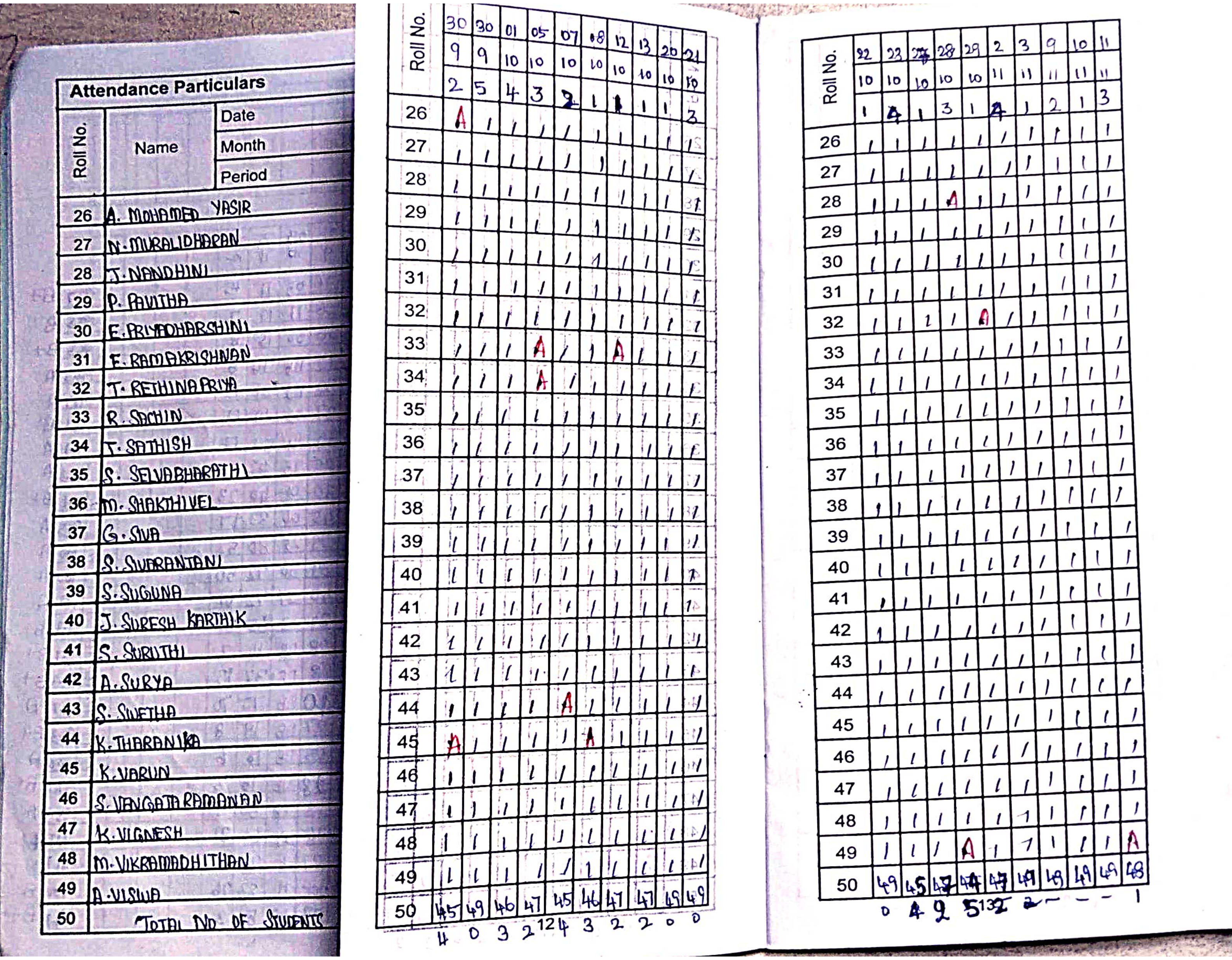
25										

Students Academic Assessment Details

Roll No.		Assignment (Date) 1	2	3	Attendance 1	2	3	4	Test AT-I	AT-II	AT-III						Over all Attendance	
	Announcement	31.8.21			13.9.2021	7.[illegible].2021	5.11.2021	30.11.2021	Date									
	Submission	14.9.21			18.8.2021 (12)	14.9.2021 (13)	8.10.2021 (12)	6.11.2021 (8)	21/9	23/10	25/11	27/12						
1		50	50		12	13	11	8	26	05	11	15					97.7	B+
2		50	50		10	13	12	8	26	11	17	7					95.5	B
3		50	50		11	13	11	8	26	06	15	8					95.5	B+
4		50	50		11	11	12	8	25	AB	14	6					93.3	A
5		50	50		12	12	12	8	30	AB	36	13					97.7	A
6		50	50		10	11	11	7	27	05	19	AB					86.6	B+
7		50	50		11	11	11	8	34	14	51	AB					91.1	A
8		50	50		11	12	11	8	25	25	42	19					93.3	A
9		50	50		11	11	11	8	30	01	40	23					91.1	B+
10		50	50		11	12	12	8	45	06	33	17					95.5	A
11		50	50		12	13	12	8	39	25	80	52					100	A
12		50	50		12	13	12	8	39	36	72	50					100	A
13		50	50		12	13	12	8	40	27	72	61					100	A
14		50	50		12	11	11	8	34	03	65	32					93.3	B+
15		50	50		12	11	10	8	28	AB	14	7					91.1	B+
16		50	50		11	12	11	8	28	AB	37	13					93.3	B+
17		50	50		11	13	12	8	40	AB	75	70					97.7	A
18		50	50		11	12	11	8	27	AB	19	8					93.3	B+
19		50	50		11	11	10	8	25	AB	16	6					88.8	A
20		50	50		12	12	12	8	28	AB	16	3					97.7	B+
21		50	50		12	11	12	8	28	AB	50	9					95.5	A
22		50	50		9	12	12	8	36	17	61	31					91.1	B+
23		50	50		10	12	11	8	27	6	26	7					91.1	B+
24		50	50		12	13	12	8	25	11	23	26					100	A
25		50	50		10	12	11	8	33	AB	50	3					91.1	B+

Attendance Particulars											
Roll No.	Name: Date	19	24	25	26	27	31	1	2	3	7
	Month	8	8	8	8	8	8	9	9	9	9
	Period	5	3	1	5	4	3	1	5	4	3
26	A. MOHAMED YASIR	/	/	/	/	/	/	/	/	A	/
27	N. MURALIDHARAN	/	/	/	/	/	/	/	/	/	/
28	J. NANDHINI	A	/	/	/	/	/	/	/	/	/
29	P. PAVITHA	/	/	/	/	A	/	/	/	/	/
30	E. PRIYADHARSHINI	/	/	/	/	/	/	/	/	/	/
31	E. RAMAKRISHNAN	/	/	/	/	/	/	/	/	/	/
32	T. SETHINAPRIYA	/	/	/	/	/	/	/	/	/	/
33	R. SACHIN	/	/	/	/	/	/	/	/	/	/
34	T. SATHISH	A	/	A	/	/	/	/	/	/	/
35	S. SELVABHARATHI	/	/	/	/	/	/	/	/	A	/
36	M. SHAKTHIVEL	/	/	/	/	/	A	/	/	/	/
37	G. SIVA	/	/	/	/	/	/	/	/	/	/
38	S. SIVARANJANI	/	/	/	/	A	/	/	/	/	/
39	S. SUGUNA	/	A	/	/	/	/	/	/	/	/
40	J. SURESH KARTHIK	/	/	/	/	/	/	/	A	A	/
41	S. SRUTHI	/	/	/	/	/	/	/	/	/	/
42	A. SURYA	/	/	/	/	A	/	/	/	/	/
43	S. SWETHA	/	/	/	/	/	/	/	/	/	/
44	K. THARANIKA	/	/	A	/	/	/	/	/	/	/
45	K. VARUN	/	/	/	/	/	A	/	/	/	/
46	S. VENGATARAMANAN	/	/	/	/	/	A	/	/	/	/
47	K. VIGNESH	/	/	/	/	/	A	/	/	/	/
48	M. VIKRAMADHITHAN	/	/	/	/	/	/	/	/	/	/
49	A. VISWA	/	/	A	/	/	/	/	/	/	/
50	TOTAL NO OF STUDENTS PRESENT	45	44	45	43	46	44	46	48	45	47
	10 ABSENT	4	5	4	6	3	5	[illegible]	[illegible]	4	2

Roll No.	8	9	14	15	16	17	23	24	28	29
	9	9	9	9	9	9	9	9	9	9
	1	B	3	1	5	4	1	4	3	1
26	/	/	/	/	A	/	/	/	/	/
27	/	/	/	/	/	/	/	/	/	/
28	/	/	/	/	/	/	/	A	/	/
29	/	/	/	/	/	/	/	A	/	/
30	/	/	/	/	A	/	/	/	/	/
31	/	/	/	/	A	/	/	/	/	/
32	/	/	/	/	/	/	/	/	/	/
33	/	/	/	/	/	/	/	A	/	A
34	A	/	/	/	/	A	/	/	/	/
35	/	/	/	/	/	/	/	/	/	/
36	/	/	/	/	/	/	/	/	/	/
37	/	/	/	/	/	/	/	/	/	/
38	A	/	/	/	/	/	/	/	/	/
39	/	/	/	/	/	/	/	/	/	/
40	/	A	/	/	/	/	/	/	/	/
41	/	/	/	/	/	/	/	/	/	/
42	/	/	/	/	/	/	/	/	/	/
43	/	/	/	/	/	/	/	/	/	/
44	/	/	/	/	/	/	/	/	/	/
45	/	/	/	/	/	/	/	/	/	/
46	/	/	/	/	/	/	/	/	/	/
47	/	/	A	/	/	/	/	/	A	/
48	/	/	/	/	/	/	/	/	/	/
49	/	/	/	/	/	/	/	/	/	/
50	47	47	45	46	44	46	45	45	47	47
	2	2	4	3	11 5	3	4	4	2	2



Attendance Particulars

Roll No.	Name
26	A. MOHAMED YASIR
27	N. MURALIDHARAN
28	J. NANDHINI
29	P. PAVITHA
30	E. PRIYADHARSHINI
31	E. RAMAKRISHNAN
32	T. RETHINA PRIYA
33	R. SACHIN
34	T. SATHISH
35	S. SELVABHARATHI
36	M. SHAKTHIVEL
37	G. SIVA
38	S. SIVARANJANI
39	S. SUGUNA
40	J. SURESH KARTHIK
41	S. SURUTHI
42	A. SURYA
43	S. SWETHA
44	K. THARANIKA
45	K. VARUN
46	S. VENGATA RAMANAN
47	K. VIGNESH
48	M. VIKRAMADHITHAN
49	A. VISWA
50	TOTAL NO OF STUDENTS

Roll No.	30/9	30/9	01/10	05/10	07/10	08/10	12/10	13/10	20/10	21/10
(Period)	2	5	4	3	2	1	1	1	1	3
26	A	/	/	/	/	/	/	/	/	3
27	/	/	/	/	/	/	/	/	/	/
28	/	/	/	/	/	/	/	/	/	/
29	/	/	/	/	/	/	/	/	/	/
30	/	/	/	/	/	/	/	/	/	/
31	/	/	/	/	/	/	/	/	/	/
32	/	/	/	/	/	/	/	/	/	/
33	/	/	/	A	/	/	A	/	/	/
34	/	/	/	A	/	/	/	/	/	/
35	/	/	/	/	/	/	/	/	/	/
36	/	/	/	/	/	/	/	/	/	/
37	/	/	/	/	/	/	/	/	/	/
38	/	/	/	/	/	/	/	/	/	/
39	/	/	/	/	/	/	/	/	/	/
40	/	/	/	/	/	/	/	/	/	/
41	/	/	/	/	/	/	/	/	/	/
42	/	/	/	/	/	/	/	/	/	/
43	/	/	/	/	/	/	/	/	/	/
44	/	/	/	/	A	/	/	/	/	/
45	A	/	/	/	/	A	/	/	/	/
46	/	/	/	/	/	/	/	/	/	/
47	/	/	/	/	/	/	/	/	/	/
48	/	/	/	/	/	/	/	/	/	/
49	/	/	/	/	/	/	/	/	/	/
50	45	49	46	47	45	46	47	47	49	49

4 0 3 2 12 4 3 2 2 0 0

Roll No.	22/10	23/10	27/10	28/10	29/10	2/11	3/11	9/11	10/11	11/11
(Period)	1	4	1	3	1	4	1	2	1	3
26	/	/	/	/	/	/	/	/	/	/
27	/	/	/	/	/	/	/	/	/	/
28	/	/	/	A	/	/	/	/	/	/
29	/	/	/	/	/	/	/	/	/	/
30	/	/	/	/	/	/	/	/	/	/
31	/	/	/	/	/	/	/	/	/	/
32	/	/	/	/	A	/	/	/	/	/
33	/	/	/	/	/	/	/	/	/	/
34	/	/	/	/	/	/	/	/	/	/
35	/	/	/	/	/	/	/	/	/	/
36	/	/	/	/	/	/	/	/	/	/
37	/	/	/	/	/	/	/	/	/	/
38	/	/	/	/	/	/	/	/	/	/
39	/	/	/	/	/	/	/	/	/	/
40	/	/	/	/	/	/	/	/	/	/
41	/	/	/	/	/	/	/	/	/	/
42	/	/	/	/	/	/	/	/	/	/
43	/	/	/	/	/	/	/	/	/	/
44	/	/	/	/	/	/	/	/	/	/
45	/	/	/	/	/	/	/	/	/	/
46	/	/	/	/	/	/	/	/	/	/
47	/	/	/	/	/	/	/	/	/	/
48	/	/	/	/	/	/	/	/	/	/
49	/	/	/	A	/	/	/	/	/	A
50	49	45	47	44	47	49	49	49	49	48

0 4 2 5 13 2 2 – – – 1

Attendance Particulars

Roll No.	Name		12	16	16	16	19	24	1	10		
		Month	11	11	11	11	11	11	12	12		
		Period	1	4	5	6	1	4&5	4&5	1-3		
26	A. MOHAMED YASIR		/	/	/	/	/	/	/	/		
27	N. MURALIDHARAN		/	/	/	/	/	/	/	/		
28	J. NANDHINI		/	/	/	/	/	/	/	/		
29	P. PAVITHA		/	A	A	A	/	/	/	/		
30	E. PRIYADHARSHINI		/	/	/	/	/	/	/	/		
31	E. RAMAKRISHNAN		/	/	/	/	/	/	/	/		
32	T. RETHINAPRIYA		/	/	/	/	/	/	/	/		
33	R. SACHIN		/	/	/	/	/	/	/	/		
34	T. SATHISH		/	/	/	/	/	/	/	/		
35	S. SELVABHARATHI		/	/	/	/	/	/	/	/		
36	M. SHAKTHIVEL		/	/	/	/	/	/	/	/		
37	G. SIVA		/	/	/	/	/	/	/	/		
38	S. SUBRANJANI		/	/	/	/	/	/	/	/		
39	S. SUGUNA		/	/	/	/	/	/	/	/		
40	J. SURESH KARTHIK		/	/	/	/	/	/	/	/		
41	S. SURUTHI		/	A	A	A	/	/	/	/		
42	A. SURYA		/	/	/	/	/	/	/	/		
43	S. SWETHA		/	/	/	/	/	/	/	/		
44	K. THARANIKA		/	/	/	/	/	/	/	/		
45	K. VARUN		/	/	/	/	/	/	/	/		
46	S. VENGATARAMANAN		/	/	/	/	/	/	/	/		
47	K. VIGNESH		/	/	/	/	/	/	/	/		
48	M. VIKRAMADHITHAN		/	/	/	/	/	/	/	/		
49	A. VISWA		/	/	/	/	/	/	/	/		
50	TOTAL NO OF STUDENTS P		48	47	47	47	49	49	49	49		

1 2 2 2 14

Attendance Particulars		
Roll No.	Name	Date / Month / Period
26	A. MOHAMED YASIR	
27	N. MURALIDHARAN	
28	J. NANDHINI	
29	P. PAVITHA	
30	E. PRIYADHARSHINI	
31	E. RAMAKRISHNAN	
32	T. SETHINAPRIYA	
33	R. SACHIN	
34	T. SATHISH	
35	S. SELVABHARATHI	
36	M. SHAKTHIVEL	
37	G. SIVA	
38	S. SUBRANJANI	
39	S. SUGUNA	
40	J. SURESH KARTHIK	
41	S. SRUTHI	
42	A. SURYA	
43	S. SWETHA	
44	K. THARANIKA	
45	K. VARUN	
46	S. VENGATARAMANAN	
47	K. VIGNESH	
48	M. VIKRAMADHITHAN	
49	A. VISWA	
50	TOTAL NO OF S	

Roll N										
26										
27										
28										
29										
30										
31										
32										
33										
34										
35										
36										
37										
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42										
43										
44										
45										
46										
47										
48										
49										
50										

Students Academic Assessment Details

Roll No.	Assignment (Date)				Attendance				Test									
		1	2	3	1	2	3	4	AT-I	AT-II	AT-III						Over all Attendance	
	Announcement	31.8.21			13.9.21	7.10.21	5.11.21	30.11.21	Date									
	Submission	14.9.21			18.8.21 (12)	14.9.21 (13)	8.10.21 (12)	6.11.21 (8)	21/9	23/10	25/11	27/12						
26	50	50	50		11	11	12	8	26	17	24	15					93.3	B
27		50	50		12	13	12	8	28	15	46	20					100	B+
28		50	50		11	12	11	8	37	15	62	21					93.3	B+
29		50	50		11	12	12	5	42	14	38	24					88.8	B+
30		50	50		12	12	12	8	33	9	36	20					97.7	B+
31		50	50		12	12	12	8	28	19	43	17					97.7	B+
32		50	50		12	13	11	8	30	AB	35	11					97.7	A
33		50	50		12	10	11	8	28	05	21	1					91.1	B+
34		50	50		9	11	12	8	25	AB	57	AB					88.8	B+
35		50	50		11	13	12	8	25	AB	10	8					97.7	B+
36		50	50		11	13	12	8	28	26	38	24					97.7	B+
37		50	50		12	13	12	8	26	6	26	11					100	B+
38		50	50		10	13	12	8	33	11	50	25					95.5	B+
39		50	50		11	13	12	8	41	25	60	57					97.7	A
40		50	50		9	13	12	8	32	AB	49	3					93.3	A
41		50	50		12	13	12	5	39	AB	63	36					93.3	A
42		50	50		11	13	12	8	37	26	64	33					97.7	A
43		50	50		12	13	12	8	39	35	80	50					100	A+
44		50	50		11	12	12	8	34	AB	35	5					95.5	A
45		50	50		11	12	11	8	28	AB	30	13					93.3	B+
46		50	50		11	13	12	8	30	05	35	8					97.7	A
47		50	50		11	11	12	8	28	03	51	6					93.3	A
48		50	50		12	13	12	8	31	AB	57	50					100	B+
49		50	50		11	13	11	7	29	AB	AB	2					93.3	B+
50																		

A ⇒ 20

B = 2 B+ ⇒ 26 A+ ⇒ 1

Students Academic Assessment Details

Roll No.	Assignment (Date)				Attendance				Test								
	Announcement	1	2	3	1	2	3	4	AT-I	AT-II	~~AT-III~~ MODEL						Over all Attendance
	Submission								Date								
									21/9	23/10	25/11	27/12					
51																	
52																	
53																	
54																	
55																	
56																	
57																	
58																	
59																	
60																	
61																	
62																	
63																	
64																	
65																	
66																	
67																	
68																	
69																	
70																	
71																	
72																	
73																	
No. of Students	Passed								48	8	19	7					
	Pass%							100	26.6	26.6	39.5	15.2					
	Between 60 to 80										11	—					
	Above 80										0	>					

Unit No.	Date	RECORD OF CLASS WORK TOPICS COVERED	PERIOD	CUMULATIVE PERIOD	STAFF INITIAL	HOD INTIAL
	19.08.2021	INTRODUCTION TO FORMAL PROOF	5	1	[signature]	
	24.08.2021	ADDITIVE FORMS OF PROOF	3	2	[signature]	
	25.08.2021	INDUCTIVE PROOFS	1	3	[signature]	
	26.08.2021	FINITE AUTOMATA	5	4	[signature]	
	27.08.2021	DFA	4	5	[signature]	[signature] 27/8
	31.08.2021	NFA	3	6	[signature]	
	1.9.2021	NFA – PROBLEMS.	1	7	[signature]	
	02.09.2021	FINITE AUTOMATA WITH ε-TRANSITIONS	5	8	[signature]	
	03.09.2021	FINITE AUTOMATA WITH ε-TRANSITIONS	4	9	[signature]	[signature] 3/9

Hours Planned: 9

Hours Handled: 9

68

RECORD OF CLASS WORK

Unit No.	Date	TOPICS COVERED	PERIOD	CUMULATIVE PERIOD	STAFF INITIAL	HOD INTIAL
	7.9.2021	REGULAR EXPRESSIONS.	3	10	[signature]	
	8.9.2021	REGULAR EXPRESSIONS - Representation	1	11	[signature]	
	9.9.2021	FA & Regular Expressions - $R_{ij}^{(k)}$ formula	3	12	[signature]	[signature] 9/9
	14.9.2021	FA & Regular Expressions - Thomson Construction Method	3	13	[signature]	
	15.9.2021	FA & Regular Expressions - State Elimination, Arden's Theorem	1	14	[signature]	
	16.9.2021	Proving languages not to be regular	5	15	[signature]	
	17.9.2021	Closure properties of Regular language	4	16	[signature]	
	23.9.2021	Equivalence & minimization of Automata	1	17	[signature]	
	24.9.2021	Equivalence & Minimization of Automata	4	18	[signature]	[signature] 24/9

Hours Planned: 9

Hours Handled: 9

Unit No.	Date	RECORD OF CLASS WORK TOPICS COVERED	PERIOD	CUMULATIVE PERIOD	STAFF INITIAL	HOD INTIAL
	28.9.2021	Context Free Grammar	3	19	[signature]	
	29.9.2021	Context Free Grammar	1	20	[signature]	
	30.9.2021	PARSE TREE	7	21	[signature]	
	30.9.2021	AMBIGUITY IN GRAMMARS & LANGUAGES	5	22	[signature]	
III						
	01.10.2021	DEFINITION OF PUSH DOWN AUTOMATA.	4	23	[signature]	[signature] 8/10
	05.10.2021	LANGUAGES OF A PDA	3	24	[signature]	
	~~07.10.2021 & 08.10.2021~~		~~7 4~~	~~25~~	[signature]	
	07.10.2021	EQUIVALENCE OF PDA & CFG.	2	25	[signature]	
	08.10.2021		1	26	[signature]	
	12.10.2021	DETERMINISTIC PUSH DOWN AUTOMATA	3	27	[signature]	[signature] 8/10

Hours Planned: 9

Hours Handled: 9

RECORD OF CLASS WORK

Unit No.	Date	TOPICS COVERED	PERIOD	CUMULATIVE PERIOD	STAFF INITIAL	HOD INTIAL
		NORMAL FORMS FOR CFG.				
	13.10.2021	(i) SIMPLIFICATION OF CFG	1	28		
	20.10.2021	(ii) CHOMSKY NORMAL FORM	1	29		
	21.10.2021	(iii) GREIBACH NORMAL FORM	3	30		
	22.10.2021	PUMPING LEMMA FOR CFL	1	31		
	23.10.2021	CLOSURE PROPERTIES OF CFL	4	32		
IV	27.10.2021	TURING MACHINES	1	33		
	28.10.2021	" "	3	34		
	29.10.2021	PROGRAMMING TECHNIQUES FOR TM	1	35		
	2.11.2021	" " " "	4	36		

Hours Planned: 9 Hours Handled: 9

RECORD OF CLASS WORK

Unit No.	Date	TOPICS COVERED	PERIOD	CUMULATIVE PERIOD	STAFF INITIAL	HOD INTIAL
	03.11.2021	NON RECURSIVE ENUMERABLE LANGUAGE	1	37		
	09.11.2021	DIAGONALIZATION LANGUAGE	2	38		
	10.11.2021	UNDECIDABLE PROBLEM WITH RE	1	39		
	11.11.2021	UNIVERSAL TURING MACHINE	3	40		
	12.11.2021	UNDECIDABLE PROBLEM ABOUT TM	1	41		
V	16.11.2021	RICE THEOREM	4	42		
	16.11.2021	POST CORRESPONDANCE PROBLEM	5&6	44		
	19.11.2021	THE CLASS P AND NP	1	45		

Hours Planned: 9 Hours Handled: 9

Unit No.	Date	RECORD OF CLASS WORK TOPICS COVERED	PERIOD	CUMULATIVE PERIOD	STAFF INITIAL	HOD INTIAL
		CONTENT BEYOND SYLLABUS				
	7.12.21	Tractable & Intractable Problem	4			
	9.12.21	REVISION – NFA to DFA	[illegible]			
	10.12.21	REVISION – Regular expression to DFA	3			

Verified
23/3/22

23/3/22

Hours Planned: Hours Handled:

KINGS COLLEGE OF ENGINEERING

CONTINUOUS ASSESSMENT TEST – I (SEPTEMBER 2021)

CS8501 – THEORY OF COMPUTATION

Class : III CSE **Date & Session : 21.09.21 & AN**

Maximum Marks : 50 **Time : 2.00 PM – 3.30 PM**

Answer all the questions

PART – A (5 * 2 = 10)

1. Illustrate the concept of Finite Automaton.
2. What is the principle of mathematical induction?
3. Compare DFA and NFA.
4. What is meant by regular expression?
5. Outline the theorem of pumping lemma for regular languages.

PART – B (2 * 13 = 26)

6. a.(i) Given $\sum$= {a,b}, construct a DFA which recognize the language L={b^m ab^n: m, n>0} (6)

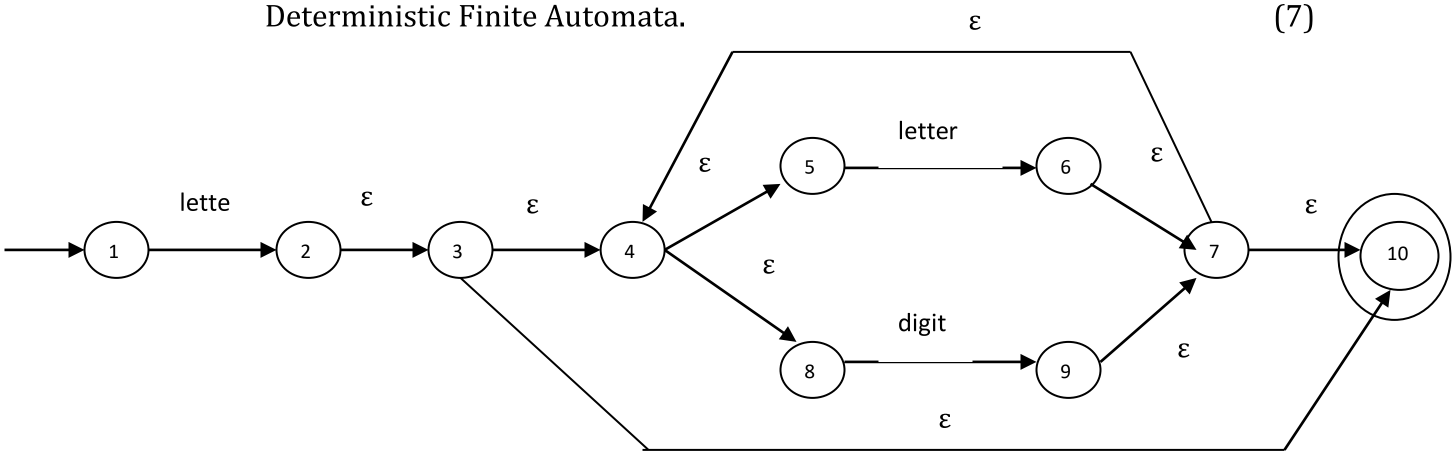
(ii)Determine the DFA from a given NFA M=({q_0, q_1},{a,b},δ, q_0, {q_1}) with the state table diagram for δ given below. (7)

δ	a	b
->q0	{q0,q1}	{q1}
* q1	ϕ	{q0,q1}

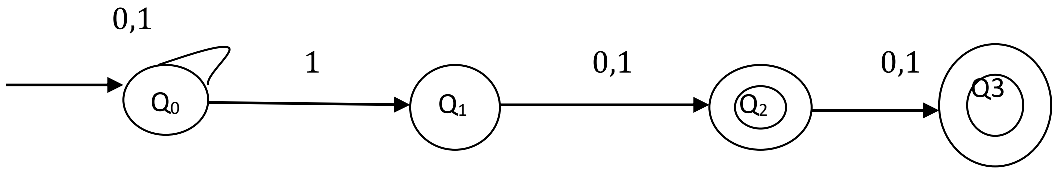
(OR)

b. (i). Prove that if x>=4 then $2^x >= x^2$ (6)

(ii).Consider the following ε-NFA for an identifier. Construct equivalent Deterministic Finite Automata. (7)



7. a. i. Deduct the regular expression from the following NFA. (6)



ii.Examine given language L={0^{2n}}n>=1} is regular or not. (7)

(OR)

b.i. Deduct the ε - NFA with epsilon for the Regular expression$(a|b)^*ab$ (6)

ii. Examine that L={a^p | p is a prime} is regular or not (7)

PART – C (1 * 14 = 14)

8. a. Construct a DFA equivalent to the NFA M=({p,q,r,s},{0,1},p,{q,s})where δ is given by, (14)

δ	0	1
→p	{q,s}	{q}
* q	{r}	{q,r}
r	{s}	{p}
*s	-	{p}

(OR)

b.i. Test the following by the principle of induction $\sum_{k=1} k^2 = \frac{n(n+1)(2n+1)}{6}$ (7)

ii. Test for every n>=1 by mathematical induction $\sum^n i^3 = \{n(n+1)/2\}^2$ (7)

PART	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
A	2,4	1,3,5				
B			6.a.i & 6.a.ii			
			6.b.i & 6.b.ii	7.a.ii & 7.b.ii		
					7.a.i & 7.b.i	
C						8.a
						8.b.i & 8.b.ii
Total	4	6	13	7	6	14

ANNEXURE - I
KINGS COLLEGE OF ENGINEERING
CONTINUOUS ASSESSMENT TEST – I (SEP '2021)

College Code	8	2	1	1										
College Name	Kings college of Engineering													
Register Number	8	2	1	1	1	9	1	0	4	0	0	8		
Name of the Candidate	A.B. Avudaiappan													
Degree	B.E													
Branch	CSE				Semester	V								
Subject Code	C	S	8	5	0	1								
Subject Name	Theory of computation													
Date	21	09	21	Session	FN	AN ✓								
No. of Pages used	5	In words	Five											
All particulars given above by me are verified and found to be correct														
Signature of the Student with date	Avud 21/9/21													

For Office Use Only

Instructions to the Candidate: Put Tick mark (✓) for the questions attended in the tick mark column against each question

PART – A			PART – B & C							Grand Total (in words)
Question No.	✓	Marks	Question No.		(i) ✓	(i) Marks	(ii) ✓	(ii) Marks	Total Marks	
1	✓	2	6	a						
2	✓	2		b						
3	✓	2	7	a						Three fours.
4	✓	2		b	✓	7	✓	6	13	
5	✓	2	8	a						
				b	✓	8		3	8+3	
										Grand Total
Total		10							24	34

Declaration by the Examiner: Verified that all the questions attended by the student are valued and the total is found to be correct

Date	Name of the Examiner	Signature of the Examiner
30/9/2021	S.Puvaneswari	S. Puv

Department of Computer Science & Engineering
Academic Year 2021-22 / ODD Semester

Class / Sem : III / V Sub Code/Subject : CS8501 / Theory of Computation

Subject Incharge : Ms.S.Puvaneswari Date of Exam: 21.9.21

Continuous Assessment Test - I

R.No	Reg No.	Name of the Student	CAT-I (out of 50)
1	821119104001	Aarthi. R	36
2	821119104002	Aiyappan. S	26
3	821119104003	Ajay Prasanna. G S	26
4	821119104005	Akash .K	25
5	821119104006	Akshayalakshmi. G	30
6	821119104007	Aravind. A	27
7	821119104008	Avudaiappan .A B	34
8	821119104009	Bakiya Lakshmi .A	25
9	821119104010	Balakrishnan. M	30
10	821119104011	Bavya. S	45
11	821119104012	Bhavatharani .T	39
12	821119104013	Deepika. P	39
13	821119104014	Devipriya. S	40
14	821119104015	Dharani. G	34
15	821119104016	Divakaran. J	28
16	821119104017	Elayadharshini .T	28
17	821119104018	Fasila Afreen .J	40
18	821119104019	Gokul .M	27
19	821119104020	Gomathi .A	25
20	821119104021	Gopinath. P	28
21	821119104022	Govindharajan. K	28
22	821119104023	Kamali. K	36
23	821119104024	Kanishkar .K	27
24	821119104025	Karkuzhali. N	25
25	821119104026	Karthika. R	33
26	821119104027	Mohamed Yasir. A	26
27	821119104028	Muralidharan. N	28
28	821119104029	Nandhini. J	37
29	821119104031	Pavitha .P	42
30	821119104032	Priyadharshini .E	33
31	821119104033	Ramakrishnan .E	28
32	821119104034	Rethinapriya. T	30
33	821119104035	Sachin .R	28
34	821119104037	Sathish .T	25
35	821119104038	Selvabharathi. S	25
36	821119104039	Shakthivel .M	28

R.No	Reg No.	Name of the Student	CAT-I (out of 50)
37	821119104040	Siva .G	26
38	821119104041	Sivaranjani . S	33
39	821119104043	Suguna. S	41
40	821119104044	Suresh Karthik .J	32
41	821119104045	Suruthi. S	39
42	821119104046	Surya. A	37
43	821119104047	Swetha. S	39
44	821119104048	Tharanika. K	34
45	821119104049	Varun. K	28
46	821119104050	Vengatramanan. S	30
47	821119104051	Vignesh. K	28
48	821119104052	Vikiramadhithan .M	31
49	821119104053	Viswa .A	29

30/9/21
STAFF INCHARGE

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KINGS COLLEGE OF ENGINEERING

CONTINUOUS ASSESSMENT TEST – II (OCTOBER 2021)

CS8501 – THEORY OF COMPUTATION

Class : III CSE **Date & Session : 23.10.21 & AN**

Maximum Marks : 50 **Time : 2.15 PM - 3.45 PM**

Answer all the questions

PART – A (5 * 2 = 10)

1. What are the closure properties of regular languages?
2. Let ∑={0,1} and $∑^1$={0,1,2} with h(0)=01 and h(1)=112. Find h(010) and homomorphic image of L={00,010}.
3. Write a Context Free Grammar for the language consisting of equal number of a's and b's
4. Give a formal definition of Push Down Automata?
5. Derive a string 'aababa' for the following Context Free Grammar (CFG) S→aSX|b; X→Xb|a

PART – B (2 * 13 = 26)

6. a. (i). Construct DFA for the regular expression 0(0+1)*1 (6)

   (ii). Minimize the number of states of DFA for the above regular expression (7)

(Or)

7. b. (i) Construct DFA for the regular expression (00+11)*01 (6)

   (ii). Minimize the number of states of DFA for the above regular expression (7)

(13)

8. a. i) Build a PDA to accept $\{0^n1^n|n>1\}$. Draw the transition diagram for the PDA. Show by instantaneous description that the PDA accepts the string '0011' (6)

   ii) Determine the pushdown automata that accepts $\{\omega c\omega^R|\omega$ is in $(0+1)^*\}$. (7)

(Or)

b. (i) Prove that if L is N(M1)(Language accepted by empty stack) for some PDA M1,then L is N(M2)(Language accepted by final state) for some PDA and model it with suitable diagram. (6)

(ii) Prove that if L is N(M1)(Language accepted by final state) for some PDA M1,then L is N(M2)(Language accepted by empty stack) for some PDA and model it with suitable diagram. (7)

PART – B (1 * 14 = 14)

9. a. Assume $M=(\{q0,q1\},\{0,1\},\{x,z0\},\delta,q0,z0)$ where δ is given by $\delta(q0,0,z0)=\{(q0,xz0)\}$, $\delta(q1,1,x)=\{(q1,\varepsilon)\}$, $\delta(q0,0,x)=\{(q0,xx)\}$ $\delta(q1,\varepsilon,x)=\{(q1,\varepsilon)\}$ $\delta(q1,\varepsilon,z0)=\{(q1,\varepsilon)\}$ Construct a CFG for the PDA. (14)

(Or)

b. (i) Convert PDA to CFG. PDA is given by $P=(\{p,q\},\{0,1\},\{X,Z\},\delta,q,Z)$, δ is defined by $\delta(p,1,Z)=(p,XZ)\}$, $\delta(p, \varepsilon,z)=\{(P, \varepsilon)\}$, $\delta(p, 1,x)=\{(p,XX)\}$, $\delta(q,1,X)=\{(q, \varepsilon)\}$, $\delta(p,0,X)=\{(q,X)\}$, $\delta(q,0,Z)=\{(p,Z)\}$ (7)

(ii).Examine DPDA. Give example for Non-deterministic and DPDA (7)

PART	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
A	1,3,4	2,5				
B						6.a.i & ii
						6.b.i & ii
			7.a.i (6)		7.a.ii (7)	
			7.b.i(6)		7.b.ii(7)	
C				8.a (14)		
				8.b.i & ii (14)		
Total	6	4	6	14	7	13

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CONTINUOUS ASSESSMENT TEST- I / II / MODEL EXAMINATION

REGISTER NUMBER 8 2 1 1 1 9 1 0 4 0 1 3

ROLL NO.	12
YEAR / BRANCH / SECTION	III / CSE / ON

College Code & Name	8 2 1 1	Kings college of engineering	
Degree/Branch	BE - CSE		
Subject Code	CS8501	Subject Title	Theory of computation

Semester	V
Date & session	23.10.21 / AN
No. of pages used	12

All the particulars given are verified	
Signature of the Invigilator with date	MB 23/10/21
Name of the Invigilator	M.BALAJI

Instructions to the candidates

1. You are prohibited from writing your **NAME** in any part of the answer book.
2. You are prohibited from writing or leaving any distinguishing marks so as to identify your answer book.
3. Use both side of the paper for answering questions (Except front page).
4. Check the regulation, Degree, Branch, Semester, Subject code and Subject Title of the Question Paper before answering the questions.
5. Possession of any incriminating material and Malpractice of any nature shall be punishable as rules.
6. **No additional sheets will be provided.**

....

SPACE FOR MARKS

36	
50	100

N. P. 25/10/21

Signature of the Examiner with Date

S. Puvaneswari

Name of the examiner

Signature of the Student with Date after Evaluation

P. Leepika 28/10/21.

Department of Computer Science & Engineering
Academic Year 2021-22 / ODD Semester

Class / Sem : III / V
Sub Code/Subject : CS8501 / Theory of Computation
Subject Incharge : Ms.S.Puvaneswari
Date of Exam: 23.10.21

Continuous Assessment Test - II

R.No	Reg No.	Name of the Student	CAT - II (out of 50)
1	821119104001	Aarthi. R	5
2	821119104002	Aiyappan. S	11
3	821119104003	Ajay Prasanna. G S	6
4	821119104005	Akash .K	AB
5	821119104006	Akshayalakshmi. G	AB
6	821119104007	Aravind. A	5
7	821119104008	Avudaiappan .A B	14
8	821119104009	Bakiya Lakshmi .A	25
9	821119104010	Balakrishnan. M	1
10	821119104011	Bavya. S	6
11	821119104012	Bhavatharani .T	25
12	821119104013	Deepika. P	36
13	821119104014	Devipriya. S	27
14	821119104015	Dharani. G	3
15	821119104016	Divakaran. J	AB
16	821119104017	Elayadharshini .T	AB
17	821119104018	Fasila Afreen .J	AB
18	821119104019	Gokul .M	AB
19	821119104020	Gomathi .A	AB
20	821119104021	Gopinath. P	AB
21	821119104022	Govindharajan. K	AB
22	821119104023	Kamali. K	17
23	821119104024	Kanishkar .K	6
24	821119104025	Karkuzhali. N	11
25	821119104026	Karthika. R	AB
26	821119104027	Mohamed Yasir. A	17
27	821119104028	Muralidharan. N	15
28	821119104029	Nandhini. J	15
29	821119104031	Pavitha .P	14
30	821119104032	Priyadharshini .E	9
31	821119104033	Ramakrishnan .E	19
32	821119104034	Rethinapriya. T	AB
33	821119104035	Sachin .R	5
34	821119104037	Sathish .T	AB
35	821119104038	Selvabharathi. S	AB
36	821119104039	Shakthivel .M	26

R.No	Reg No.	Name of the Student	CAT-II (out of 50)
37	821119104040	Siva .G	6
38	821119104041	Sivaranjani . S	11
39	821119104043	Suguna. S	25
40	821119104044	Suresh Karthik .J	AB
41	821119104045	Suruthi. S	AB
42	821119104046	Surya. A	26
43	821119104047	Swetha. S	35
44	821119104048	Tharanika. K	AB
45	821119104049	Varun. K	AB
46	821119104050	Vengatramanan. S	5
47	821119104051	Vignesh. K	3
48	821119104052	Vikiramadhithan .M	AB
49	821119104053	Viswa .A	AB

25/10/21
STAFF INCHARGE

25/10
HOD

KINGS COLLEGE OF ENGINEERING

MODEL EXAM (NOVEMBER 2021)

CS8501 – THEORY OF COMPUTATION

Class/Sem : III CSE / 05 Date & Session: 25.11.21 & FN

Maximum : 100 Time: 9.45 am to 12.45 pm

ANSWER ALL THE QUESTIONS

PART – A (10 * 2 = 20 Marks)

1. Define Finite Automata.
2. Outline the concepts of principle of mathematical induction.
3. What is meant by regular expression?
4. Summarize the definition of pumping lemma for regular set.
5. Build CFG for a signed integer constant in C
6. Compare PDA acceptance by empty stack method with acceptance by the final state method
7. Illustrate the configuration of Turing Machine
8. Define simplification of CFG.
9. Identify the properties of recursive and recursive enumerable language.
10. Summarize the concepts of NP-hard and NP-completeness problem.

PART – B (5 * 13 = 65 Marks)

11. a.(i). Prove the following by the principle of induction $\sum_{k=1} k^2 = \frac{n(n+1)(2n+1)}{6}$. **(6)**

(ii). P.T A language is accepted by some DFA iff L is accepted by some NFA. **(7)**

(OR)

b.(i). Assess a non-deterministic finite automaton accepting the set of strings over {a,b} ending in aba. Use it to construct a DFA accepting the some set of strings. **(6)**

(ii). Deduct into DFA for the following ε-NFA **(7)**

	ε	a	b	c
→ p	{q,r}	ø	{q}	{r}
q	ø	{p}	{r}	{p,q}
*r	ø	ø	ø	ø

12. a.(i). Describe Arden's Theorem with an example. **(6)**

(ii). S.T the set L={0^{i^2} |i≥1} is not regular **(7)**

(OR)

b.(i). S.T the set L={0^n|n is a perfect square} is not regular **(6)**

(ii).Illustrate the steps to Construct an NFA from the regular expression ((a|b)*a **(7)**

13. a.(i). Construct a parse tree and compute left most derivation, rightmost derivation for a given input, (a+b) and a++ **(7)**

I→a|b|Ia|Ib|I0|I1

E→I | E+E | E* E|(E)

(ii).Construct a PDA that accept the given CFG: S→xaax, X→ax|bx|ε **(6)**

(OR)

b. (i). Solve that if L is N(M1)(Language accepted by empty stack) for some PDA M1,then L is N(M2)(Language accepted by final state) for some PDA. **(7)**

(ii). Construct PDA for the language L={ww^R|w in $(a+b)^*$}. **(6)**

14. a. List the steps to convert the following grammar into an equivalent one with no unit productions and no useless symbols (Simplification of CFG) and convert into CNF form

S-> ABA, A->aAA|aBc|bB,B-> A | bB | Cb,C->CC | cC **(13)**

(OR)

b. Show and explain in detail about programming techniques for TM **(13)**

15. a.Examine that L_{ne} is not recursive and also prove that L_{ne} is recursively enumerable. **(13)**

(OR)

b. Analyze the concepts about RICE theorem and Simplify L_u is RE but not recursive **(13)**

PART – C (1 * 15 = 15 Marks)

16. a. Construct PDA from CFG. PDA is given by P=({p,q},{0,1},{X,Z},δ,q,Z), δ is defined by δ(p,1,Z)={(p,XZ)}, δ(p, ε,z)={(P, ε)}, δ(p, 1,x)={(p,XX)}, δ(q,1,X)={(q, ε)}, δ(p,0,X)={(q,X)}, δ(q,0,Z)={(p,Z)} **(15)**

(OR)

b. Write down the steps to provide solution to the PCP problem **(15)**
The TM M={{q1,q2,q3},{0,1},{0,1,B}, δ ,q1,B,{q3}} where δ is given by δ(q1,0)={(q2,1,R)}, δ(q1,1)={(q2,0,L)}, δ(q1,B)={(q2,1,L)}, δ(q2,0)={(q3,0,L)}, δ(q2,1)={(q1,0,R)}, δ(q1,B)={(q2,0,R)} and input string w=01. Build the solution.

PART	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
A	1,3,8,10	2,4,6,7	5,9			
B	14.a	12.a.i. & ii	13.a.i & ii	15.a.i & ii	11.a.i & ii	
	14.b	12.b.i & ii	13.b.i & ii	15.b.i &ii	11.b.i & ii	
C						16.a
						16.b
Total	21	21	17	13	13	15

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TUV CERT ISO 9001

CONTINUOUS ASSESSMENT TEST- I / II / MODEL EXAMINATION

REGISTER NUMBER 8 2 1 1 1 9 1 0 4 0 1 2

ROLL NO.	19CS11
YEAR / BRANCH / SECTION	III/CSE

College Code & Name	8211	KINGS COLLEGE OF ENGINEERING	
Degree/Branch	BE/CSE		
Subject Code	CS8501	Subject Title	THEORY OF COMPUTATION

Semester	V
Date & session	25.11.21 &FN
No. of pages used	20

All the particulars given are verified	
Signature of the Invigilator with date	S. Revathi 25/11/2021
Name of the Invigilator	Dr. S. Revathi

Instructions to the candidates

1. You are prohibited from writing your **NAME** in any part of the answer book.
2. You are prohibited from writing or leaving any distinguishing marks so as to identify your answer book.
3. Use both side of the paper for answering questions (Except front page).
4. Check the regulation, Degree, Branch, Semester, Subject code and Subject Title of the Question Paper before answering the questions.
5. Possession of any incriminating material and Malpractice of any nature shall be punishable as rules.
6. **No additional sheets will be provided.**

....

SPACE FOR MARKS

80 / 100 Good

S. Puv 26/11/21

Signature of the Examiner with Date

S. Puvaneswari

Name of the examiner

Signature of the Student with Date after Evaluation

1/12/21

KINGS

Department of Computer Science & Engineering

Academic Year 2021-22 / ODD Semester

Class / Sem : III / V Sub Code/Subject : CS8501 / Theory of Computation

Subject Incharge : Ms.S.Puvaneswari Date of Exam: 25.11.21

Model Exam

R.No	Reg No.	Name of the Student	Model (out of 100)
1	821119104001	Aarthi. R	11
2	821119104002	Aiyappan. S	17
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9	821119104010	Balakrishnan. M	40
10	821119104011	Bavya. S	33
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12	821119104013	Deepika. P	72
13	821119104014	Devipriya. S	72
14	821119104015	Dharani. G	65
15	821119104016	Divakaran. J	14
16	821119104017	Elayadharshini .T	37
17	821119104018	Fasila Afreen .J	75
18	821119104019	Gokul .M	19
19	821119104020	Gomathi .A	16
20	821119104021	Gopinath. P	16
21	821119104022	Govindharajan. K	50
22	821119104023	Kamali. K	61
23	821119104024	Kanishkar .K	26
24	821119104025	Karkuzhali. N	23
25	821119104026	Karthika. R	50
26	821119104027	Mohamed Yasir. A	24
27	821119104028	Muralidharan. N	46
28	821119104029	Nandhini. J	62
29	821119104031	Pavitha .P	38
30	821119104032	Priyadharshini .E	36
31	821119104033	Ramakrishnan .E	43
32	821119104034	Rethinapriya. T	35
33	821119104035	Sachin .R	21
34	821119104037	Sathish .T	57
35	821119104038	Selvabharathi. S	10
36	821119104039	Shakthivel .M	38

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37	821119104040	Siva .G	26
38	821119104041	Sivaranjani . S	50
39	821119104043	Suguna. S	60
40	821119104044	Suresh Karthik .J	39
41	821119104045	Suruthi. S	63
42	821119104046	Surya. A	64
43	821119104047	Swetha. S	80
44	821119104048	Tharanika. K	35
45	821119104049	Varun. K	30
46	821119104050	Vengatramanan. S	35
47	821119104051	Vignesh. K	51
48	821119104052	Vikiramadhithan .M	57
49	821119104053	Viswa .A	AB

S. Pur 26/11/21
STAFF INCHARGE

26/11
HOD

KINGS COLLEGE OF ENGINEERING

MODEL EXAM - II (DECEMBER 2021)

CS8501 – THEORY OF COMPUTATION

Class/Sem : III CSE / 05 Date & Session: 27.12.21 & FN

Maximum : 100 Time: 9.30 am to 12.30 pm

ANSWER ALL THE QUESTIONS

PART – A (10 * 2 = 20 Marks)

1. State any four ways of theorem proving.
2. What is meant by proof by contradiction?
3. Identify the applications of Regular Expression
4. What are the closure properties of regular languages?
5. What is meant by Context Free Grammar?
6. List down the different types of languages accepted by DPDA.
7. Outline the steps for pumping lemma for CFL.
8. Infer the Instantaneous description of TM.
9. What is the measuring complexity for NFA?
10. Define PCP or Post Correspondence Problem.

PART – B (5 * 13 = 65)

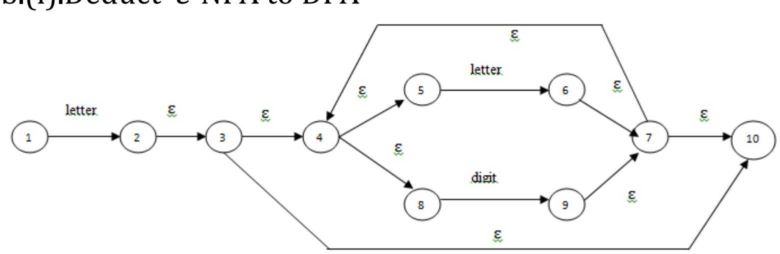
`

11. a.(i). Prove that if x>=4 then $2^x >= x^2$ **(7)**

(ii).Prove every tree has 'e' edges and 'e+1' nodes. **(6)**

(OR)

b.(i).Deduct ε-NFA to DFA **(7)**



(ii). Construct a non-deterministic finite automaton accepting the set of strings over {a,b} ending in aba. **(6)**

12. a. Show that the regular language are closed under: **(13)**

   a. Union
   b. Intersection
   c. Kleene Closure
   d. Complement
   e. Difference

(OR)

b. Build the finite automaton for the regular expression (0+1)*0(0+1)* **(13)**

13. a.(i).Outline the steps to construct a pushdown automata to accept the language $L=\{a^nb^n/n\geq1\}$ by empty stack **(6)**

(ii).Explain that there is a parse tree with root A and with yield w, then there is a leftmost derivation A => w in grammar G **(7)**

(OR)

b.(i). if G is the grammar S→SbS | a show that G is ambiguous **(6)**

(ii). Illustrate the steps to construct a PDA accepting $\{a^nb^ma^n \mid n,m >=1\}$ **(7)**

14. a.Elaborate the steps to convert into Chomsky Normal Form (CFG) equivalent to the grammar G with the productions P given. **(13)**

$S\rightarrow aAbB$, $A\rightarrow aA| \in$, $B\rightarrow bB| \in$

(OR)

b.Design a Turing machine to accept language $L=\{0^n1^n/n>=1\}$ and simulate its action on the input 0011 **(13)**

15. a.(i). Solve that if a language is recursive iff it & its complement are both RE **(7)**

(ii).if L is a recursive language so is complement of L **(6)**

(OR)

b.(i).S.T L_u is recursively enumerable **(7)**

(ii).S.T modified PCP reduces to PCP **(6)**

PART – C (1 * 15 = 15)

16. a. Examine in detail about Class P and NP with an example **(15)**

(Or)

b.Simplify the following grammar into GNF **(15)**

S→AB , A→BS | b, B→SA | a

PART	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
A	1,2,4,5,6,9,10	3,7,8				
B	11.a.i & ii	12.a	13.a.i & ii			
	11.b.i.& ii	12.b	13.b.i & ii			
		15.a.i & ii	14.a			
		15.b.i & ii	14.b			
C				16.a		
				16.b		
Total	27	32	26	15		

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Approved by AICTE, New Delhi
Affiliated to Anna University, Chennai

CONTINUOUS ASSESSMENT TEST- I / II / MODEL EXAMINATION -2

REGISTER NUMBER	8 2 1 1 1 9 1 0 4 0 1 4
ROLL NO.	19CS13
YEAR / BRANCH / SECTION	III - CSE

College Code & Name	8211	Kings college of Engineering
Degree/Branch	B.E - CSE	
Subject Code	CS8501	Subject Title: theory of computation

Semester	05
Date & session	27.12.21 / FN
No. of pages used	24

All the particulars given are verified	
Signature of the invigilator with date	[signature] 27/12/21
Name of the Invigilator	R. Sugantha Lakshmi

Instructions to the candidates

1. You are prohibited from writing your NAME in any part of the answer book.
2. You are prohibited from writing or leaving any distinguishing marks so as to identify your answer book.
3. Use both side of the paper for answering questions (Except front page).
4. Check the regulation, Degree, Branch, Semester, Subject code and Subject Title of the Question Paper before answering the questions.
5. Possession of any incriminating material and Malpractice of any nature shall be punishable as rules.
6. No additional sheets will be provided.

....

SPACE FOR MARKS

	67
50	100

S. Puv 29/12/21
Signature of the Examiner with Date

S. Puvaneswari
Name of the examiner

Signature of the Student with Date after Evaluation

S. De 30/12/21

A NAAC Accredited Institution
KINGS COLLEGE OF ENGINEERING
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Affiliated to Anna University, Chennai

Department of Computer Science & Engineering
Academic Year 2021-22 / ODD Semester
Class / Sem : III / V Sub Code/Subject : CS8501 / Theory of Computation
Subject Incharge : Ms.S.Puvaneswari Date of Exam: 27.12.21

Model Exam - II

R.No	Reg No.	Name of the Student	Model (out of 100)
1	821119104001	**Aarthi. R**	15
2	821119104002	**Aiyappan. S**	7
3	821119104003	**Ajay Prasanna. G S**	8
4	821119104005	Akash .K	6
5	821119104006	**Akshayalakshmi. G**	13
6	821119104007	**Aravind. A**	AB
7	821119104008	**Avudaiappan .A B**	AB
8	821119104009	**Bakiya Lakshmi .A**	19
9	821119104010	**Balakrishnan. M**	23
10	821119104011	**Bavya. S**	17
11	821119104012	**Bhavatharani .T**	52
12	821119104013	**Deepika. P**	50
13	821119104014	**Devipriya. S**	67
14	821119104015	**Dharani. G**	32
15	821119104016	**Divakaran. J**	7
16	821119104017	Elayadharshini .T	13
17	821119104018	**Fasila Afreen .J**	70
18	821119104019	Gokul .M	8
19	821119104020	Gomathi .A	6
20	821119104021	**Gopinath. P**	3
21	821119104022	**Govindharajan. K**	9
22	821119104023	**Kamali. K**	31
23	821119104024	**Kanishkar .K**	7
24	821119104025	**Karkuzhali. N**	26
25	821119104026	**Karthika. R**	3
26	821119104027	**Mohamed Yasir. A**	15
27	821119104028	**Muralidharan. N**	20
28	821119104029	**Nandhini. J**	21
29	821119104031	**Pavitha .P**	24
30	821119104032	**Priyadharshini .E**	20
31	821119104033	**Ramakrishnan .E**	17
32	821119104034	**Rethinapriya. T**	11
33	821119104035	Sachin .R	1
34	821119104037	**Sathish .T**	AB
35	821119104038	**Selvabharathi. S**	8
36	821119104039	**Shakthivel .M**	24

R.No	Reg No.	Name of the Student	Model (out of 100)
37	821119104040	Siva .G	11
38	821119104041	Sivaranjani . S	25
39	821119104043	Suguna. S	57
40	821119104044	Suresh Karthik .J	3
41	821119104045	Suruthi. S	36
42	821119104046	Surya. A	33
43	821119104047	Swetha. S	50
44	821119104048	Tharanika. K	5
45	821119104049	Varun. K	13
46	821119104050	Vengatramanan. S	8
47	821119104051	Vignesh. K	6
48	821119104052	Vikiramadhithan .M	50
49	821119104053	Viswa .A	2

30/12/21
STAFF INCHARGE

30/12
HOD

Course File

Format A

ASSIGNMENT

TITLE : Problems with Finite Automata and Regular Expression, Ambiguous Grammar

OBJECTIVE :

- Understand the concept of Finite Automata
- Know the difference between NFA and DFA
- Convert NFA into DFA
- Convert NFA into regular expression and vice versa.
- Determine given grammar is ambiguous or not.

METHODOLOGY : Descriptive Answers

EVALUATION : 50 Marks awarded for the conversion process

DATE OF COMPLETION : 25.9.21

27/9/21
Staff Incharge

27/9
HoD/CSE

NAME : T.BHAVATHARANI

ROLLNO : 19CS11

REGNO : 821119104012

SUBCODE : CS8501

SUBJECT : THEORY OF COMPUTATION

ASSIGNMENT-I

28/9/21

PART-A

1) Define Finite Automaton:

*Finite automata is a mathematical models which always accepts regular languages.

*A finite automata is a collection of 5 tuples $(Q, \Sigma, \delta, q_0, F)$. (Q14).

⇒ Q = finite set of states which is non empty

⇒ Σ = input alphabet.

⇒ q_0 = initial state $q_0 = Q$

⇒ F = set of final states

⇒ δ = transition / mapping function.

Enumerate the difference between NFA and DFA.

S.NO	DFA	NFA
1.	Every input string leads to the unique state of FA.	For the same input there can be more than one next state.
2.	conversion of regular expression to DFA is complex	Here it is easier.
3.	DFA requires more memory for storing state information.	NFA requires more computations to match r.e. with input.
4.	In DFA there is no ϵ-transitions.	In NFA ϵ-transitions are possible.

(3) Write down the rules for pumping Lemma for regular Languages.

Rules for pumping lemma for regular languages:

Generating small strings, $\boxed{z = uvw}$

* Length of uv, $|uv| \leq n$
* length of v, $|v| \geq 1$
* Length of $uv^i w \in L$, for all $i = 0, 1, \ldots$

where, n = Number of states in regular expression.

(4) Define ambiguous grammar.

A Grammar is said to be ambiguous, if there exists two or more derivation tree for a string so (that means two or more left derivation trees).

Example: $G = \{\{S\}, \{a+b, +, *\}, P, S\}$, where P consists of $S \rightarrow S+S \mid S*S \mid a \mid b$

The string a+a*b can be generated as

$S \rightarrow S+S$	$S \rightarrow S+S$
$\rightarrow a+S$	$\rightarrow S+S*S$
$\rightarrow a+S*S$	$\rightarrow a+S*S$
$\rightarrow a+a*S$	$\rightarrow a+a*S$
$\rightarrow a+a*b$	$\rightarrow a+a*b$

5) What is meant by derivation?

Derivation tree or parse tree is a graphical representation for the derivation of the system production rules for a given of G.

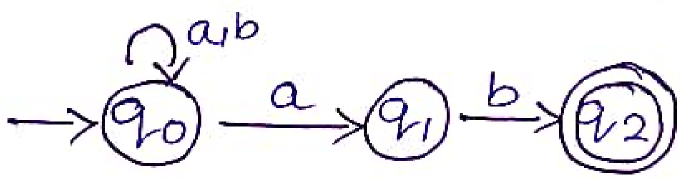
Types of derivation:

* Left most derivation
* Right most derivation.

PART-B

1) prove the equivalent of NFA and DFA using subset construction.

Equivalent of NFA and DFA using subset construction:



$Q = \{q_0, q_1, q_2\}$

possible subset $\Rightarrow 2^3 = 8$

Step-1: Sub $= \{\phi, \{q_0\}, \{q_1\}, \{q_2\}, \{q_0, q_1\}, \{q_0, q_2\}, \{q_1, q_2\}, \{q_0, q_1, q_2\}\}$

Step-2:

Transition table:

	a	b
A – ϕ	ϕ	ϕ
B → q_0	$\{q_0, q_1\}$	q_0
C – q_1	ϕ	q_2
D – q_2^*	ϕ	ϕ
E – $\{q_0, q_1\}$	$\{q_0, q_1\}$	$\{q_0, q_1\}$
F – $\{q_0, q_2\}^*$	$\{q_0, q_1\}$	q_0
G – $\{q_1, q_2\}^*$	ϕ	q_2
H – $\{q_0, q_1, q_2\}^*$	$\{q_0, q_1\}$	$\{q_0, q_2\}$

	a	b
A	A	A
→B	E	B
C	A	D
D*	A	A
E	E	F
F*	E	B
G*	A	D
H*	E	F

Step-3:

To ~~dete~~ eliminate the unwanted state

Transition table:

DFA:

	a	b
→B	E	B
E	E	F
F*	E	B

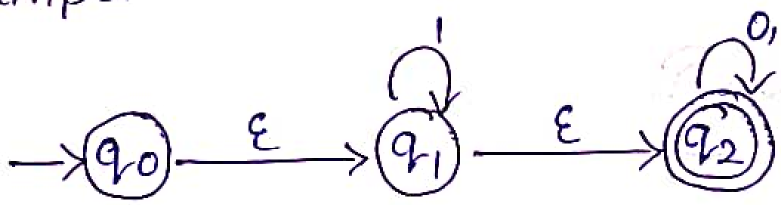
2) Explain in detail about Finite Automata with ε moves with an example.

Finite Automaton with ε moves:

Definition:

The ε transitions in NFA are given in order to move from one state the another without having any symbol from input set Σ (CO23)

Example:



NFA with ε can be represented by the same 5 tuple of finite automata

$M = (Q, \Sigma, \delta, q_0, F)$

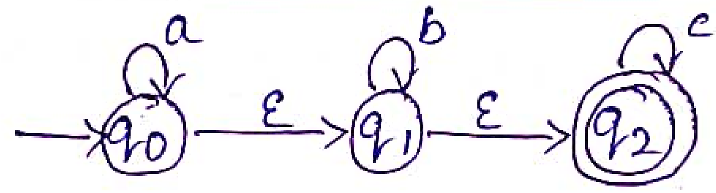
where transition function as $Q^* (\Sigma \cup \{\varepsilon\}$ to 2^Q

The string 'w' in L is accepted by NFA can be represented as

$L(M) = \{ w \mid w \varepsilon^*$ and δ transition for w from q_0 to $F\}$

problem:

construct NFA with ε which accepts a language consisting the strings of any no. of. a's followed by any no. of. 's followed by no. of. c's

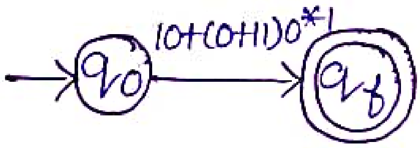


③ a) construct a ε-NFA for the regular expression 10+(0+11)0*1.

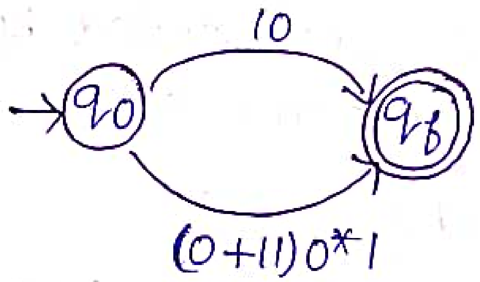
ε-NFA for regular expression:

Given: 10+(0+11)0*1.

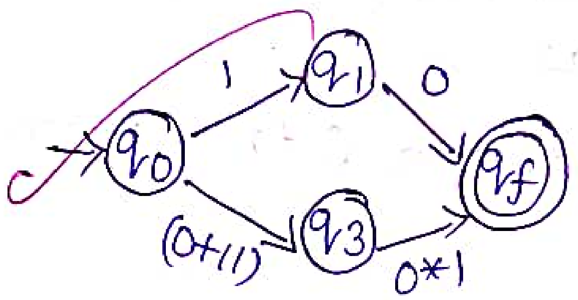
step-1:



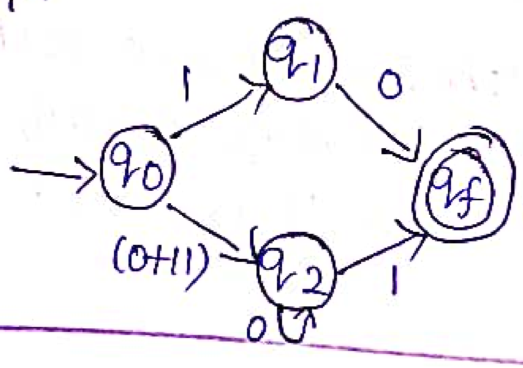
step-2:



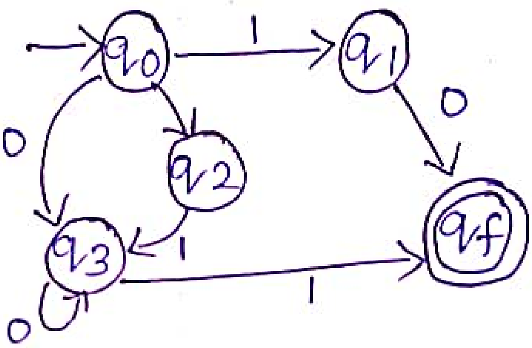
step-3:



step-4:



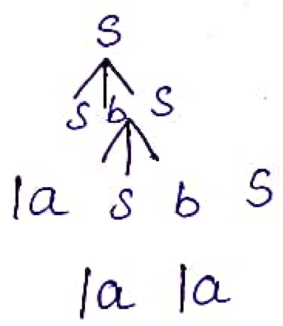
Step-5:



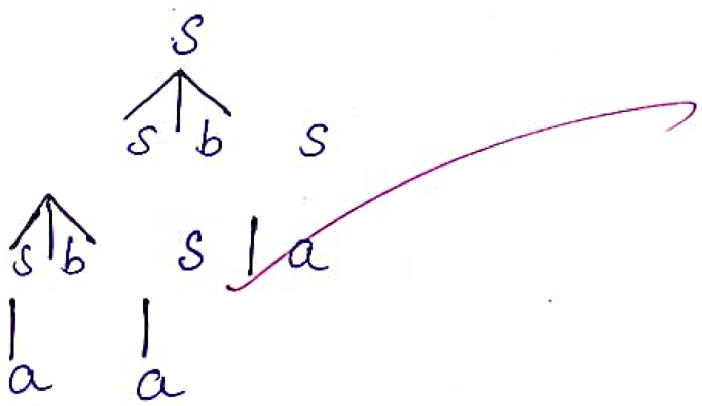
b) If G is the grammar S→SbS / a show that G is ambiguous.

parse trees using the given grammar to drive the string 'ababa'.

parse tree-1:



parse tree-2:



∴ Hence the given grammar is ambiguous.

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
ACADEMIC YEAR 2021 – 2022 (ODD SEMESTER)

YEAR / SEM : III / V
CS8501 / Theory of Computation
Total No of Students: 49

PCE SUMMARY REPORT

S.NO	ACTIVITY	WEIGHTAGE	NO OF STUDENTS PARTICIPATED
1.	GATE Question Paper Solving	10	49
2.	Problem Solving	10	49
3.	Quiz	10	49
4.	NPTEL Swayam Assignment Questions	10	49
5.	Mind Map	10	46
6.	Simulation	10	3

Staff Incharge

HOD/CSE

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
ACADEMIC YEAR 2021-2022 / ODD SEMESTER
Year/Sem : III / V CS8501 - Theory of Computation
PCE ACTIVITY REPORT

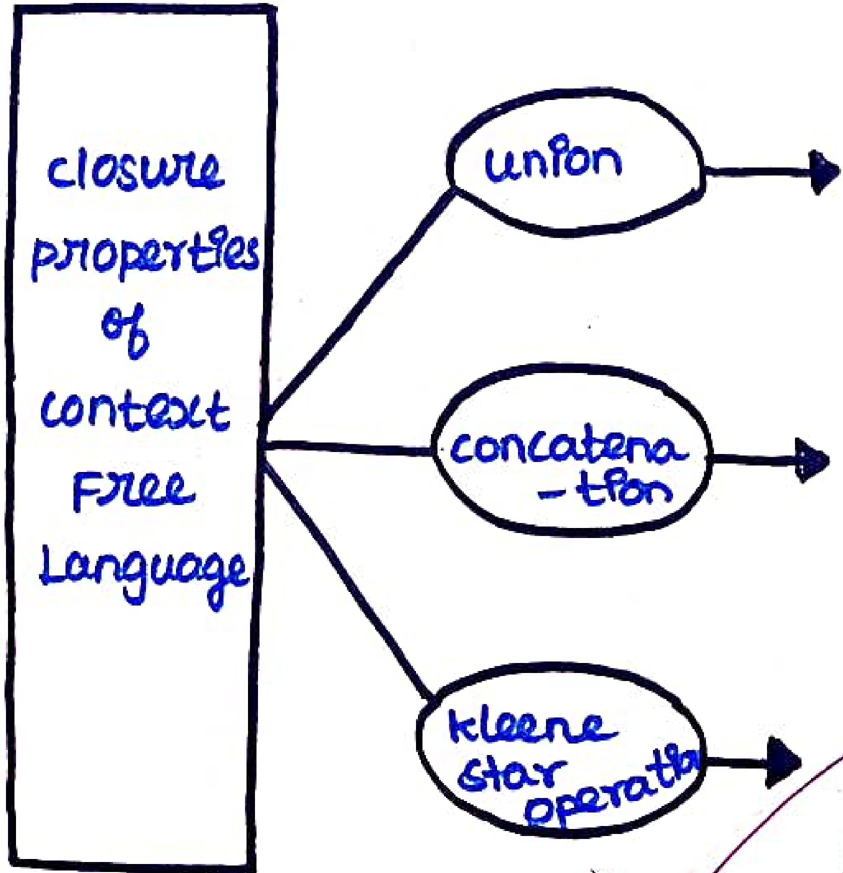
S.NO	REGISTER NO	NAME	GATE QP	Problem Solving	Quiz	NPTEL SWAYAM Assignment	Mind Map	Simulation	Total
			10	10	10	10	10	10	50
1.	82111910400	Aarthi. R	10	10	10	10	10		50
2.	82111910400	Aiyappan. S	10	10	10	10	10		50
3.	82111910400	Ajay Prasanna. G	10	10	10	10	10		50
4.	82111910400	Akash .K	10	10	10	10	10		50
5.	82111910400	Akshayalakshmi	10	10	10	10	10		50
6.	82111910400	Aravind. A	10	10	10	10	10		50
7.	82111910400	Avudaiappan .A	10	10	10	10	10		50
8.	82111910400	Bakiya Lakshmi	10	10	10	10	10		50
9.	82111910401	Balakrishnan. M	10	10	10	10	10		50
10.	82111910401	Bavya. S	10	10	10	10	10		50
11.	82111910401	Bhavatharani .T	10	10	10	10	10		50
12.	82111910401	Deepika. P	10	10	10	10	10		50
13.	82111910401	Devipriya. S	10	10	10	10	10		50
14.	82111910401	Dharani. G	10	10	10	10	10		50
15.	82111910401	Divakaran. J	10	10	10	10	10		50
16.	82111910401	Elayadharshini	10	10	10	10	10		50
17.	82111910401	Fasila Afreen .J	10	10	10	10		10	50
18.	82111910401	Gokul .M	10	10	10	10	10		50
19.	82111910402	Gomathi .A	10	10	10	10		10	50
20.	82111910402	Gopinath. P	10	10	10	10	10		50
21.	82111910402	Govindharajan.	10	10	10	10	10		50
22.	82111910402	Kamali. K	10	10	10	10	10		50
23.	82111910402	Kanishkar .K	10	10	10	10	10		50
24.	82111910402	Karkuzhali. N	10	10	10	10	10		50
25.	82111910402	Karthika. R	10	10	10	10	10		50

S.NO	REGISTER NO	NAME	GATE QP	Problem Solving	Quiz	NPTEL SWAYAM Assignment	Mind Map	Simulation	Total
			10	10	10	10	10	10	50
26.	821119104027	Mohamed Yasir.	10	10	10	10	10		50
27.	821119104028	Muralidharan. N	10	10	10	10	10		50
28.	821119104029	Nandhini. J	10	10	10	10	10		50
29.	821119104031	Pavitha .P	10	10	10	10	10		50
30.	821119104032	Priyadharshini	10	10	10	10	10		50
31.	82111910403	Ramakrishnan	10	10	10	10	10		50
32.	821119104034	Rethinapriya. T	10	10	10	10	10		50
33.	82111910403	Sachin .R	10	10	10	10	10		50
34.	821119104037	Sathish .T	10	10	10	10	10		50
35.	821119104038	Selvabharathi. S	10	10	10	10	10		50
36.	821119104039	Shakthivel .M	10	10	10	10	10		50
37.	821119104040	Siva .G	10	10	10	10	10		50
38.	821119104041	Sivaranjani . S	10	10	10	10	10		50
39.	821119104043	Suguna. S	10	10	10	10	10		50
40.	821119104044	Suresh Karthik .J	10	10	10	10		10	50
41.	821119104045	Suruthi. S	10	10	10	10	10		50
42.	821119104046	Surya. A	10	10	10	10	10		50
43.	821119104047	Swetha. S	10	10	10	10	10		50
44.	821119104048	Tharanika. K	10	10	10	10	10		50
45.	821119104049	Varun. K	10	10	10	10	10		50
46.	821119104050	Vengatramanan.	10	10	10	10	10		50
47.	821119104051	Vignesh. K	10	10	10	10	10		50
48.	821119104052	Vikiramadhitha	10	10	10	10	10		50
49.	821119104053	Viswa .A	10	10	10	10	10		50

Staff Incharge

HOD/CSE

MIND MAPPING



$L_1 = \{a^n b^n, n>0\}$. corresponding grammar G_1 will have P: $S_1 \to aAb \mid ab$

$L_2 = \{c^m d^m, m \geq 0\}$. corresponding grammar G_2 will have P: $S_2 \to cBb \mid \epsilon$

$L = L_1 \cup L_2 = \{a^n b^n\} \cup \{c^m d^m\}$

union of the Languages L_1 and L_2,

$L = L_1 L_2 = \{a^n b^n c^m d^m\}$

The corresponding grammar G will have the additional production $S_1 \to S_1 S_2$

$L = \{a^n b^n, n \geq 0\}$. corresponding grammar G will have P: $S \to aAb \mid \epsilon$

$L_1 = \{a^n b^n\}^*$

Course File

Format B

CONTENT BEYOND THE SYLLABUS

TITLE : Tractable and Intractable Problem

OBJECTIVE : Understand the applications of NP problems

METHODOLOGY : Powerpoint Presentation

COVERAGE :

- Classification of algorithm based on complexity
- Example of tractable and intractable problem

OUTCOME : The students able to,

- Classify the algorithms
- Determine which applications are tractable.

EVALUATION : Test on the above concept included in model exam

DATE OF COMPLETION : 19.11.21

S. Pu 22/11/21
Staff Incharge

22/11
HoD/CSE

Tractable and Intractable Problem

Introduction

- Let's start by reminding ourselves of some common functions, ordered by how fast they grow.
- constant O(1)
- logarithmic O(log n)
- linear O(n) n-log-n O(n × log n)
- quadratic O(n 2)
- cubic O(n 3)
- exponential O(k n),
- e.g. O(2n) factorial O(n!)
- super-exponential e.g. O(n n)

Types of Function

- **Polynomial functions**: Any function that is O(n k), i.e. bounded from above by n k for some constant k.
- E.g. O(1), O(log n), O(n), O(n × log n), O(n 2), O(n 3)
- **Exponential functions**: The remaining functions. E.g. O(2n), O(n!), O(n n)

Types of Algorithm

- Polynomial-Time Algorithm: an algorithm whose order-of-magnitude time performance is bounded from above by a polynomial function of n, where n is the size of its inputs.
- Exponential Algorithm: an algorithm whose order-of-magnitude time performance is not bounded from above by a polynomial function of n.

Tractable & Intractable Problem

- Tractable Problem: a problem that is solvable by a polynomial-time algorithm. The upper bound is polynomial.
- Intractable Problem: a problem that cannot be solved by a polynomial-time algorithm. The lower bound is exponential.

Polynomial Time

- Most of the algorithms we have looked at so far have been
- **polynomial-time algorithms**
- • On inputs of size *n, their worst-case running time is O(nk) for some*
- constant *k*
- • The question is asked can all problems be solved in polynomial time?
- • From what we've covered to date the answer is obviously no. There
- are many examples of problems that cannot be solved by any computer
- no matter how much time is involved
- • There are also problems that can be solved, but not in time O(*nk) for*
- any constant *k*

NP Problems

- Another class of problems are called NP problems
- • These are problems that we have yet to find efficient algorithms in
- Polynomial Time for, but given a solution we can verify that solution
- in polynomial time
- • Can these problems be solved in polynomial time?
- • It has not been proved if these problems can be solved in polynomial
- time, or if they would require superpolynomial time
- • This so-called P != NP question is one which is widely researched and
- has yet to be settled

Deterministic Vs Non Deterministic

- Let us now define some terms
- **– P: The set of all problems that can be solved by deterministic**
- algorithms in polynomial time
- • By *deterministic we mean that at any time during the operation of the*
- algorithm, there is only one thing that it can do next
- • A nondeterministic algorithm, when faced with a choice of several
- options, has the power to “guess“ the right one.
- • Using this idea we can define NP problems as,
- **– NP:The set of all problems that can be solved by nondeterministic**
- algorithms in polynomial time.

NP - Complete

- **NP-complete problems are set of problems that have been proved to be**
- in NP
- • That is, a nondeterministic solution is quite trivial, and yet no
- polynomial time algorithm has yet been developed.
- • This set of problems has an additional property which does seem to
- indicate that P = NP
- • If any of the problems can be solved in polynomial time on a
- deterministic machine, then all the problems can be solved in NP(Cook's
- Theorem)
- • It turns out that many interesting practical problems have this
- characteristic

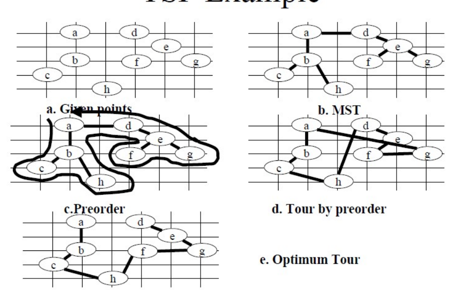
examples of tractable problems

- Searching an unordered list
- Searching an ordered list
- Sorting a list
- Multiplication of integers (even though there’s a gap)
- Finding a minimum spanning tree in a graph (even though there’s a gap)

Examples of Intractable problem

- Some of them require a non-polynomial amount of output, so they clearly will take a non-polynomial amount of time,
- e.g.: ∗ Towers of Hanoi: we can prove that any algorithm that solves this problem must have a worst-case running time that is at least 2n − 1.
- ∗ List all permutations (all possible orderings) of n numbers. – Others have polynomial amounts of output, but still cannot be solved in polynomial time:
- ∗ For an n × n draughts board with an arrangement of pieces, determine whether there is a winning strategy for White (i.e. a sequence of moves so that, no matter what Black does, White is guaranteed to win).

TSP Example



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

ACADEMIC YEAR 2021 - 2022 ODD SEMESTER

SUB CODE/SUBJECT: CS8501 / THEORY OF COMPUTATION
BATCH:2019-2023

ADVANCED LEARNER LIST

S.No	Register Number	Student Name
1.	821119104008	Avudaiappan .A B
2.	821119104012	Bhavatharani .T
3.	821119104013	Deepika. P
4.	821119104014	Devipriya. S
5.	821119104018	Fasila Afreen .J
6.	821119104023	Kamali. K
7.	821119104029	Nandhini. J
8.	821119104045	Suruthi. S
9.	821119104047	Swetha. S
10.	821119104049	Varun. K
11.	821119104052	Vikiramadhithan .M

SLOW LEARNERS LIST

S.No	Register Number	Student Name
1.	821119104005	Akash .K
2.	821119104007	Aravind. A
3.	821119104021	Gopinath. P
4.	821119104027	Mohamed Yasir. A
5.	821119104035	Sachin .R
6.	821119104050	Vengatramanan. S
7.	821119104053	Viswa .A

S.Puri

STAFF INCHARGE

HOD/CSE

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
ACADEMIC YEAR 2021 – 2022 (ODD SEMESTER)
REVISION CLASS TIME TABLE (With effect from 15.11.21)

YEAR/SEM:III / V
VENUE: Room No: 224

FN: 9.30 AM to 12.30 PM
AN: 1.15 PM to 4.00 PM

S.NO	DATE	SUBJECT CODE & NAME (FN)	SUBJECT CODE & NAME (AN)
1.	15.11.21 (Monday)	[1]CS8592 - Object Oriented Analysis and Design Dr.S.M.Uma	[1]OMF551 - Product Design and Development Mr.R.Sriramkumar
2.	16.11.21 (Tuesday)	[1]CS8591 - Computer Networks Dr.D.Sivakumar	[1]CS8501 - Theory of Computation Ms.S.Puvaneswari
3.	17.11.21 (Wednesday)	[1]MA8551- Algebra and Number Theory Dr.G.Jeyakrishnan	[1]EC8691 - Microprocessor and Microcontroller Mr.R.Thandayuthapani
4.	18.11.21 (Thursday)	[2]CS8592 - Object Oriented Analysis and Design Dr.S.M.Uma	[2]OMF551 - Product Design and Development Mr.R.Sriramkumar
5.	19.11.21 (Friday)	[2]CS8501 - Theory of Computation Ms.S.Puvaneswari	[2]CS8591 - Computer Networks Dr.D.Sivakumar
6.	20.11.21 (Saturday)	[2]EC8691 - Microprocessor and Microcontroller Mr.R.Thandayuthapani	[2]MA8551- Algebra and Number Theory Dr.G.Jeyakrishnan
		MODEL EXAMINATION	**REVISION**
7.	22.11.21 (Monday)	MA8551- Algebra and Number Theory Dr.G.Jeyakrishnan (MODEL EXAM)	[3]CS8591 - Computer Networks Dr.D.Sivakumar
8.	23.11.21 (Tuesday)	CS8591 - Computer Networks Dr.D.Sivakumar(MODEL EXAM)	[3]EC8691 - Microprocessor and Microcontroller Mr.R.Thandayuthapani
9.	24.11.21 (Wednesday)	EC8691 - Microprocessor and Microcontroller Mr.R.Thandayuthapani(MODEL EXAM)	[3]CS8501 - Theory of Computation Ms.S.Puvaneswari
10.	25.11.21 (Thursday)	CS8501 - Theory of Computation Ms.S.Puvaneswari(MODEL EXAM)	[3]CS8592 - Object Oriented Analysis and Design Dr.S.M.Uma
11.	26.11.21 (Friday)	CS8592 - Object Oriented Analysis and Design Dr.S.M.Uma(MODEL EXAM)	[3]OMF551 - Product Design and Development Mr.R.Sriramkumar
12.	27.11.21 (Saturday)	OMF551 - Product Design and Development Mr.R.Sriramkumar (MODEL EXAM)	[3]MA8551- Algebra and Number Theory Dr.G.Jeyakrishnan

FN	9.30 AM to 11.30 AM	STUDY HOURS	AN	1.15 PM to 3.00 PM	STUDY HOURS
	11.30 AM to 12.30 PM	TEST HOURS		3.00 PM to 4.00 PM	TEST HOURS

10/11/21
CLASS COORDINATOR

10/11/21
HOD/CSE

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
ACADEMIC YEAR 2021-2022 / ODD SEMESTER

Year/Sem : III / V

Sub Code/ Subject: CS8501 / Theory of Computation

Revision Class Mark Statement

S.No	Reg.No	Student Name	16.11.21 (25)	19.11.21 (26)	24.11.21 (25)	25.11.21 (25)	
1.	821119104001	Aarthi. R	24	20	21	20	
2.	821119104002	Aiyappan. S	22	20	20	21	
3.	821119104003	Ajay Prasanna. G	25	19	18	20	
4.	821119104005	Akash .K	20	18	18	AB	
5.	821119104006	Akshayalakshmi.	23	21	22	21	
6.	821119104007	Aravind. A	22	18	19	AB	
7.	821119104008	Avudaiappan .A	23	25	23	22	
8.	821119104009	Bakiya Lakshmi	25	26	25	22	
9.	821119104010	Balakrishnan. M	18	18	AB	23	
10.	821119104011	Bavya. S	19	17	AB	20	
11.	821119104012	Bhavatharani .T	25	26	25	24	
12.	821119104013	Deepika. P	25	26	25	25	
13.	821119104014	Devipriya. S	25	26	25	24	
14.	821119104015	Dharani. G	23	23	22	23	
15.	821119104016	Divakaran. J	20	20	21	20	
16.	821119104017	Elayadharshini	20	21	20	21	
17.	821119104018	Fasila Afreen .J	24	25	24	24	
18.	821119104019	Gokul .M	20	20	21	20	
19.	821119104020	Gomathi .A	20	AB	20	21	
20.	821119104021	Gopinath. P	20	20	21	20	
21.	821119104022	Govindharajan.	20	22	22	AB	
22.	821119104023	Kamali. K	23	23	24	20	
23.	821119104024	Kanishkar .K	20	24	23	AB	
24.	821119104025	Karkuzhali. N	21	24	24	22	
25.	821119104026	Karthika. R	22	21	22	21	

S.No	Reg.No	Student Name	16.11.21	19.11.21	24.11.21	25.11.21	
26.	821119104027	Mohamed Yasir.	23	AB	18	20	
27.	821119104028	Muralidharan. N	24	20	23	22	
28.	821119104029	Nandhini. J	21	23	24	24	
29.	821119104031	Pavitha .P	20	20	21	20	
30.	821119104032	Priyadharshini	21	21	20	21	
31.	821119104033	Ramakrishnan .E	18	20	AB	20	
32.	821119104034	Rethinapriya. T	20	21	22	24	
33.	821119104035	Sachin .R	20	19	21	22	
34.	821119104037	Sathish .T	21	19	21	22	
35.	821119104038	Selvabharathi. S	23	24	23	24	
36.	821119104039	Shakthivel .M	22	24	23	23	
37.	821119104040	Siva .G	24	19	23	22	
38.	821119104041	Sivaranjani . S	21	23	22	24	
39.	821119104043	Suguna. S	25	25	24	25	
40.	821119104044	Suresh Karthik .J	19	18	20	AB	
41.	821119104045	Suruthi. S	20	19	24	25	
42.	821119104046	Surya. A	21	19	23	24	
43.	821119104047	Swetha. S	24	23	24	24	
44.	821119104048	Tharanika. K	23	24	22	24	
45.	821119104049	Varun. K	23	22	AB	20	
46.	821119104050	Vengatramanan.	24	25	23	22	
47.	821119104051	Vignesh. K	24	20	21	21	
48.	821119104052	Vikiramadhithan	25	25	24	23	
49.	821119104053	Viswa .A	20	AB	20	20	
No of Students Present			49	46	45	44	
No of Students Absent			-	03	4	5	
Staff Signature			[signature]	[signature]	[signature]	[signature]	
HOD Sign			[signature]	[signature]	[signature]	[signature]	

Name : BAKIYALAKSHMI . A

Class : III CSE

Subject : Theory of computation

Revision Test - 2

19.11.21

26/26

Q. i) prove that if a language is recursive if it & its complement are both RE

<u>Theorem</u> :-

⇒ If the language is recursive & its complement are both RE.

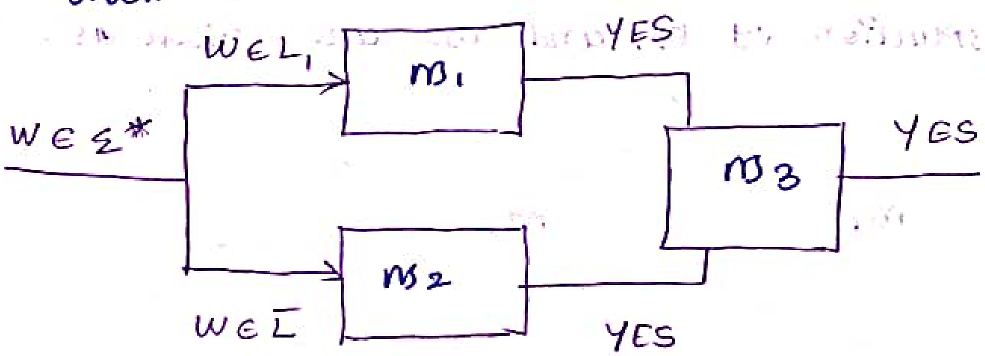
<u>proof</u> :-

⇒ Let ~~word~~ L and $\bar{L}$ be two recursively enumerable languages that are accepted by Turning Machines M_1 and M_2.

⇒ If $w \in L$ is accepted by Turning machine M_1 and M_1 that halts with answer "YES".

⇒ If $w \in \bar{L}$ [$w \notin L$] they are accepted by M_2 and M_2 that halts with answer "YES".

⇒ M_3 is simulates M_1 and M_2 are simultaneously given as.



⇒ From the abov design. If $W \in L$, If $W \in L$ is accepted by W and halts 'YES'.

⇒ If $W \in L'$ is $W[W \in L]$ they are accepted by W and halts with "YES".

⇒ M1 and M2 are accepted complements to each other.

⇒ Hence M3 is a Turning machine that halts for all strings.

⇒ Thus, the languages and its complements are recursively enumerable languages, then they are recursive.

2. (ii) If L is recursive then $\bar{L}$ is also recursive.

Theorem :-

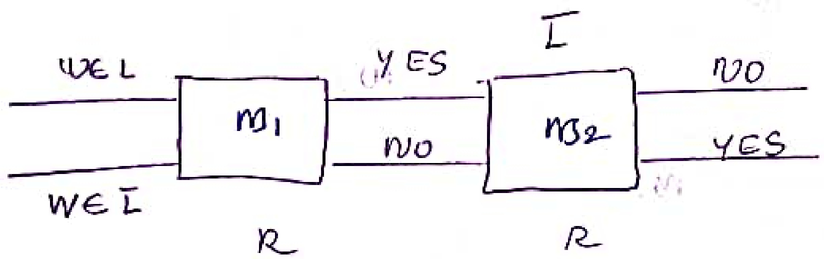
If comp $\bar{L}$ is a recursive then the complements are also recursive.

Proof :-

⇒ Let L be a recursive language Turning Machine M,

⇒ Let $\bar{L}$ be a recursive language Turning machine M2.

The construction of M1 and M2 are given as.



⇒ If $w \in L$, then they accepts M_1 and halts with "YES".

⇒ If $w \in \bar{L}$, then they accepts M_1 and halts with "NO".

⇒ M_2 is activated once halts M_1.

⇒ If M_1 returns "YES", then M_2 halts with "NO".

⇒ If M_1 returns "NO", then M_2 halts with "YES".

⇒ Thus for all w, if $w \in L$, $w \in \bar{L}$ they are accepts M_2 and halts with either "YES" or "NO".

⇒ Thus the L is recursive then its complement is also recursive.

2.ii) Theorem :-

⇒ The union of two recursive enumerable language is also recursive enumerable.

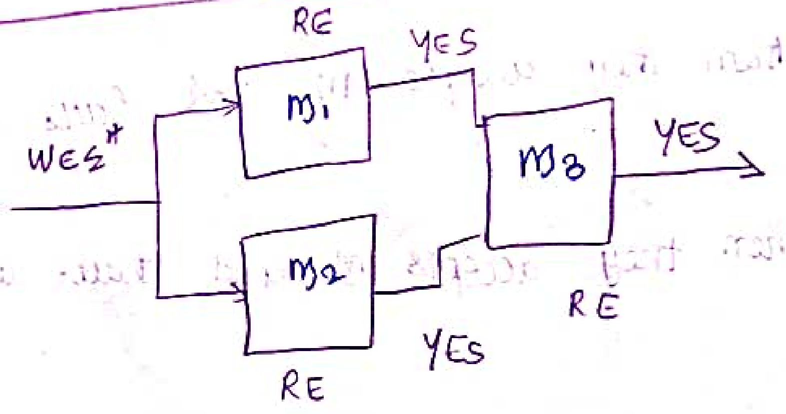
Proof :-

⇒ Let L_1 and L_2 be a recursive enumerable language halts with Turning machine M_1 and M_2.

⇒ If $w \in L_1$ then M_1 returns "YES", Else loop forever.

If $w \in L_2$ then M_2 returns "YES", Else loop forever.

⇒ The M_3 is performed on L_1 and L_2 they are given as,



⇒ Here the output of M_1 and M_2 are written as the input tape of M_3.

⇒ Turning machine M_3 is returns "YES" if atleast one outputs M_1 and M_2 is "YES".

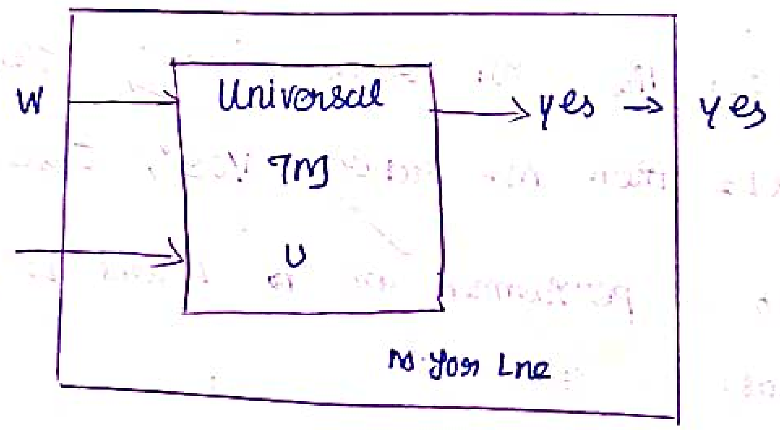
⇒ The M_3 is halts with answer, if $w \in L_1$, $w \in L_2$ accepted halts with "YES", Else M_3 loop forever that M_1 and M_2 loop is forever.

⇒ Thus the union of two recursive languages are recursive then its complement also recursive.

1.i) L_{ne} is recursively enumerable :-

proof :-

The construction is based on universal Turning machine.



These theorem proved follows as,

A

⇒ i) A turning mechine code Mi is given input to the TM.

⇒ ii) M guessed in ~~M~~ Wi is right way that Mi accepts Wi.

⇒ iii) M is simulated to the universal machine code U. where tests,

Mi accepts wi.

⇒ iv) If Mi accepts Wi then M accepts W.

⇒ Thus Mi accepts any strings Wi then is guesseded right way ~~that~~ to the M.

⇒ If $L(Mi) = \phi$ then no guessesed made to the Turning machine.

⇒ so M does not accept W.

~~Hence~~

KINGS College of Engineering

TEST REPORT – ODD SEMSTER / 2021-2022												
Department		CSE							Year /Section	III		
Name of the subject & Code		CS8501 – THEORY OF COMPUTATION							Name of the staff	S. PUVANESWARI		
Test	Date	No. of students							Reason for poor performance	Corrective action	Signature of staff	Signature of HOD
		Total	Appeared	Absent	Passed	Pass %	60 - 80	81 -100				
Assessment Test - 1	21.9.21	49	49	–	49	100%	–	–	–	–	S. Puv 30/9/21	S 30/9
Assessment Test - 2	23.10.21	49	30	19	8	26.6%	–	–	Due to rain 19 students were unable to attend the exam. Failed students didn't attend all the Part-B questions.	Retest will be conducted for absentees & failures	S. Puv 25/10/21	S 25/10
Model Exam	25.11.21	49	48	1	19	39.5%	11	–	* Failed students didn't cover all the part-B and part-C questions.	* More Revision classes will be conducted.	S. Puv 26/11/21	S 26/11
Model Exam - II	27.12.21	49	46	3	7	15.2%	–	–	* They didn't write well for model exam. * Little bit confusion in while studying Theorem in V unit	* Advised them to do more practice in solving the problems.	S. Puv 30/12/21	S 30/12
AU Exam	7.2.22	49	49	–	49	100%	–	–	–	–	S. Puv 8/4/22	S 8/4

A ⇒ 20 A+ ⇒ 1 B = 2 B+ ⇒ 26.

J. [signature] 11/4/2022.
PRINCIPAL

Note: - Report should be retained by HOD concerned

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 40395

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fifth Semester

Computer Science and Engineering

CS 8501 — THEORY OF COMPUTATION

(Regulations 2017)

Time : Three hours — Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Write regular expression to represent exponential constants of 'C' language.

2. Define extended transition diagram.

3. Write regular expression to recognize the set of strings over {a,b} having odd number of a's and b's and that starts with 'a'.

4. When two states are said to be distinguished? Give example.

5. Write CFG to accept the language defined by, $L = \{a^i b^j c^k \mid i, j, k >= 0 \text{ and } i = j + k\}$.

6. List out the steps for performing LL parsing.

7. Draw pushdown automata to accept all palindromes of odd length.

8. Formally define the pushdown automata based on the types of acceptance.

9. Draw Turing machine to compute double the value of an integer.

10. State Post's correspondence problem.

PART B — ($5 \times 13 = 65$ marks)

11. (a) Design an $\varepsilon - NFA$ (Nondeterministic finite automaton) to recognize the language L, containing only binary strings of non-zero length whose bits sum to a multiple of 3. Convert $\varepsilon - NFA$ into an equivalent minimized deterministic finite automaton. Illustrate the computation of your model on any sample input.

Or

(b) (i) State and prove the theorem of mathematical induction. (5)

(ii) In a programming language, all the following expressions represent Integer and floating point literals. Construct a finite automata that will accept all the different formats and convert the same to deterministic finite automata, if required. (8)

12. (a) (i) Prove that regular expressions are closed under union, intersection and Kleene closure. (8)

(ii) Identify a language L, such that L* = L+. (5)

Or

(b) Find a minimum State Deterministic Finite Automata recognizing the language corresponding to the regular expression (0*10 + 1 * 0) (01)*.

13. (a) What language over {0, 1} does the CFG with productions

$S \rightarrow 00S \mid 11S \mid S00 \mid S11 \mid 01S01 \mid 01S10 \mid 10S10 \mid 10S01 \mid \epsilon$ generate? Justify your answer.

Or

(b) Design an pushdown automata to recognize the language, L defined by, L $L = \{wcw^c | w \in \{0,1\}^*$ and w^c is the one's complement of $w\}$.

14. (a) Convert the following grammar to Chomsky Normal form.

$S \rightarrow A \mid AB0 \mid A1A$

$A \rightarrow A0 \mid \epsilon$

$B \rightarrow B1 \mid BC$

$C \rightarrow CB \mid CA \mid 1B$.

Or

(b) Construct an appropriate model to recognize the language L defined by, $L = \{a^n b^m c^m d^n \mid n, m >= 0\}$.

15. (a) With proper examples, explain P and NP complete problems.

Or

(b) State and prove that "Diagnoalization language is not recursively enumerable".

PART C — ($1 \times 15 = 15$ marks)

16\. (a) Design appropriate automation model for the language defined by the grammar given below.

$S \rightarrow aSBC$

$CB \rightarrow BC$

$bB \rightarrow bb$

$cC \rightarrow cc$

$S \rightarrow aBC$

$aB \rightarrow ab$

$bC \rightarrow bc$

Or

(b) Design appropriate automation model for the language defined by the grammar given below.

$S \rightarrow abc \mid aAbc$

$Ab \rightarrow bA$

$Ac \rightarrow Bbcc$

$bB \rightarrow Bb$

$aB \rightarrow aa \mid aaA.$

REVIEW SHEET

After Completion of syllabus
Faculty experience in handling / covering syllabus
Unit I :   * more hours required to describe the design part of NFA & DFA.
Unit II :   * Allocated hours enough to describe regular expression
Unit III :   * more number of examples required to understand the concept of PDA, and its conversion process.
Unit IV :   * more number of Tutorials required to understand the problems in CFG.
Unit V :   * Theorems can be explained using PPT sessions.
Difficulties (if any)   Due to mixed mode (online + offline), students couldn't understand the concepts completely. Doubt clearing sessions are very short.
Feedback on University Question Paper   Moderate Question Paper.
S.R. 8/2/22   SIGNATURE OF STAFF   [signature] 8/2   HOD/CSE