|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| PSNA College of Engineering and Technology, Dindigul – 624 622. **(An Autonomous Institution Affiliated to Anna University, Chennai)** Second Serial Test ∷ 2023-24 ∷Even semester | | | | | |
| B.E | CSE | | | | Max. Marks 100 |
| Semester IV | | | R 2022 | Set 2 | Date:28.05.24(AN) |
| CS2411 | | THEORY OF COMPUTATION | | | Time :3 Hours |
|  | |  | | |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Register Number |  |  |  |  |  |  |  |  |  |  |  |  |

|  |
| --- |
| **Course Outcomes** |
| CO1:Construct Finite Automata to solve computational problems. |
| CO2: Write an regular expression for finite automata. |
| CO3: Design context free grammar for Pushdown Automata |
| CO4: Design Turing machine for computational problems |
| CO5: Analyze undecidable problems and NP class problems |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Blooms Taxonomy Levels (BL) | | | BL1 -Remembering | BL3 -Applying | BL5 –Evaluating |
| BL2 -Understanding | BL4 –Analyzing | BL6 –Creating |
| **No** | | **Part–A: Answer All Questions. 10 x 2 = 20 Marks** | | | | | Marks | BL | CO | PI |
| 1 | | Formally define the pushdown automata based on the types of acceptance | | | | | 2 | 2 | 3 | 1.3.1 |
| 2 | | What is meant by instantaneous description of PDA? | | | | | 2 | 1 | 3 | 1.4.1 |
| 3 | | Draw Turing machine to compute double the value of an integer | | | | | 2 | 2 | 4 | 1.3.1 |
| 4 | | What are the two normal forms of CFG ? Write their productions format. | | | | | 2 | 1 | 4 | 1.4.1 |
| 5 | | Define the language recognized by any Turing Machine | | | | | 2 | 2 | 4 | 1.3.1 |
| 6 | | Show that L={ap/p is prime } is not CFL | | | | | 2 | 1 | 4 | 1.3.1 |
| 7 | | What are recursive languages? | | | | | 2 | 1 | 5 | 1.4.1 |
| 8 | | When is a recursively enumerable language said to be recursive? | | | | | 2 | 2 | 5 | 1.3.1 |
| 9 | | Difference between Decidable and Undecidable Languages. | | | | | 2 | 1 | 5 | 1.4.1 |
| 10 | | State Post’s correspondence problem | | | | | 2 | 1 | 5 | 1.3.1 |
|  | | **Part–B: Answer All Questions. 5x 13 =65 Marks** | | | | |  |  |  |  |
| 11 | | A | Find an equivalent grammar in CNF for the grammar G with productions P given S->ASB|ε A->aAS|a B->SbS|A|bb | | | | 13 | 3 | 4 | 2.3.1 |
|  | OR | | | |  |  |  |  |
| B | Design a Turing machine to accept the language L={an bm cn /m, n≥ 1} and simulate its action on the input aabbbcc | | | | 13 | 3 | 4 | 2.3.1 |
| 12 | | A | Convert the following grammar G into Greibach Normal Form (GNF) X1->X2X3 X2->X3X1 | b X3->X1X2 | a | | | | 13 | 3 | 4 | 2.3.1 |
|  | OR | | | |  |  |  |  |
| B | Construct a Turing Machine for multiplying two non-negative integers using subroutine. | | | | 13 | 3 | 4 | 2.3.1 |
| 13 | | A | (i)Explain techniques for Turing machine construction | | | | 7 | 2 | 4 | 1.4.1 |
| (ii)If L1 and L2 are recursively enumerable languages, prove that the union of L1 and L2 is also recursively enumerable | | | | 6 | 2 | 5 | 1.4.1 |
|  | **OR** | | | |  |  |  |  |
| B | (i) Explain the steps to convert CFG to PDA | | | | 7 | 2 | 4 | 1.4.1 |
| (ii) Prove that the complement of recursive language is also recursive language | | | | 6 | 2 | 5 |  |
| 14 | | A | State and prove that “Diagnoalization language is not recursively enumerable”. | | | | 13 | 2 | 5 | 1.4.1 |
|  | **OR** | | | |  |  |  |  |
| B | Every Non trivial property of the RE language is Undecidable(Rice Theorem) | | | | 13 | 2 | 5 | 1.4.1 |
| 15 | | A | Find the MPCP instance for the given Turing Machine.  M=({ q1, q2, q3},{0,1},{0,1,B}, δ, q1,B,{ q3})where δ is given as   |  |  |  |  | | --- | --- | --- | --- | |  | **δ( qi,0)** | **δ( qi,1)** | **δ( qi,B)** | | **q1** | **(q2,1,R)** | **(q2,0L)** | **(q2,1,L)** | | **q2** | **(q3,0,L)** | **(q1,0,R)** | **(q2,0,R)** | | **q3** | **--------** | **---------** | **---------** | | | | | 13 | 3 | 5 | 2.3.1 |
|  | **OR** | | | |  |  |  |  |
| B | With proper examples, explain P and NP complete problems. | | | | 13 | 3 | 5 | 2.3.1 |
|  | |  | **Part–C: Answer All Questions. 1 x 15 =15 Marks** | | | |  |  |  |  |
| 16 | | A | i)Design pushdown automata to recognize the language, L defined by, L  L={anbn /n>=1}and check whether any valid string is accepted or not. | | | | 7 | 3 | 3 | 2.3.1 |
|  | |  | ii)consider the PDA P=({q,p},{0,1},{x,z0 } , **δ** ,q, z0 ,p) convert the given PDA to context Free Grammar  **δ(q,1,** **z0 ) = (q,Xz0)**  **δ(q,1,** X**) = (q,XX)**  **δ(q,0,** **z0 ) = (p,X)**  **δ(p,0,** X**) = (p,** ε**)**  **δ(p,0,** **z0 ) = (q,X)** | | | | 8 | 3 | 3 | 2.3.1 |