Mid Semester Examination

PHI455: Philosophical Logic

HSS, IIT Kanpur

General Instructions: Read carefully each question. Fill in your with a pen and circle the correct answer on paper as well. All your work must be done in these pages.

- You have up to 120 minutes.
- For each Wrong answer 0.25% marks will be deducted.
- Please ensure that you keep a copy of your rough work and save it somewhere for future reference. Save it with the course number and and your roll number.
- Every item on the test awards 2 points for each correct answer, for a maximum possible score of 60 points.
- Multiple choice questions may have more than one answer. Circle each of the correct answer.
- Each Question in part-B consists of 5 marks each. For each wrong answer(0.25%) 1.25 M will be deducted.

SIDE A

Part I. True or False Questions. 20M

---

1. The following argument is valid in K. *It is possible that it is raining outside now and that it is possible that PHI455 exam is easy* implies that (both) *it is raining and the PHI455 exam is easy* is possible.

   A. True B. False

2. $\models_{S5} \Box\Diamond\Box\Diamond\Diamond\Box\Diamond\Box\,\alpha \leftrightarrow \Box\Diamond\,\alpha$ holds in $S5$ modal logic.

   A. True B. False

3. If there are three people A, B and C . A says B is lying; B says C is lying; and C says both A and B are lying, so C is telling the truth

   A. True B. False

4. The well formed formula (wff), $\Diamond\,(p \wedge q) \rightarrow \Box(\neg p \rightarrow q)$ is *unsatisfiable* in normal modal logic.

   A. True B. False

5. In any normal modal logic, $\Diamond$ distributes over $\wedge$, that is $\Diamond\,(\phi \wedge \psi) \equiv (\Diamond\,\phi \wedge \Diamond\psi)$

   A. True B. False

6. The well formed formula $\Box\Diamond\Diamond\Box\,p$ is in contradiction with $\Diamond\Box\Diamond\Diamond\,\neg\,p$

   A. True B. False

7. $(p \wedge q) \rightarrow \neg\,p$ is a theorem of K.

   A. True B. False

8. If the world w of a model $M = \{W, R, V\}$ has no worlds accessible to it, then at w, every formula is necessary, but none are possible. Hence, the following formula $\Box\Box\Diamond p$ is true with respect to such a world.

   A. True B. False

9. The following argument is valid in S: If Kangaroos had no tails, they would topple over. Therefore, If kangaroos had no tails but used clutches, they would topple over.

   A. True B. False

10. The following Well Formed Formula is valid in conditional logic C: $\phi > \psi \models_C (\phi \rightarrow \psi)$

    A. True B. False

11. Which of the following statements are intensional statements.
    A. Narendra Modi is the current Prime Minister of India.
    B. The square root of 9 is 3.
    C. Everyone who has read Huckleberry Finn knows that Mark Twain wrote it.
    D. It is possible that Aristotle did not tutor Alexander the Great.
    E. Aristotle was pleased that he had a sister.
    F. Mark Twain wrote Huckleberry Finn.
    G. None of the above.

12. Which of the following are well formed formulas in Modal Propositional Logic $\mathcal{L}$:
    A. $\Diamond\Box\Diamond\Diamond p \wedge \vee\Diamond(p \rightarrow q)$
    B. $(p \rightarrow \Diamond\Box(r \vee \Box \top))$
    C. $p \neg\Diamond \leftrightarrow \neg\Diamond p \vee q \wedge r$
    D. $(\Box\Diamond\Box\Diamond\Diamond \leftrightarrow \neg\Box\Diamond\Box\Diamond\Diamond(p \vee q)) \wedge (p \rightarrow (q \rightarrow p))$
    E. none of the above

13. Which of the following statements are correct or well formed formulas that holds in $S5$.
    A. $\vdash_{S5?} \Diamond\Box(\Diamond A \rightarrow \Box\Diamond A)$
    B. $\Box(\Diamond A \rightarrow \Diamond B) \vdash_{S5?} \Box\Diamond A \rightarrow \Diamond\Box B$
    C. $\Diamond \neg A \vdash_{S5?} \neg \Diamond A$
    D. $\Box(\Diamond A \vee \Diamond B) \vdash_{S5?} \Box\Diamond A \vee \Box\Diamond B$

14. Frame validity of $\Box\Box\Diamond\Box\Diamond p \leftrightarrow \Diamond p$ is dependent on accessibility relation (R) to be
    A. Symmetric
    B. Reflexive, Symmetric and transitive
    C. Reflexive and transitive
    D. Symmetric and transitive
    E. No constraints
    F. None of the above

15. Which of the following conditional statements hold in both $C1$ and $C2$
    1. $p > p$
    2. $(p \wedge q) \rightarrow (p > q)$
    3. $(p > q) \vee \neg(p > q)$
    4. $(p > q) \rightarrow (p \rightarrow q)$
    5. $(p > q) \rightarrow (\neg q > \neg p)$

    A. 3
    B. 3, 4
    C. 1, 2, 4
    D. None of the above

16. Imagine that there are three boxes that are presented to you. One contains gold, the other two are empty. Each box has imprinted on it a clue as to its contents; the clues are:

1. Box 1: The gold is not here
2. Box 2: The gold is not here
3. Box 3 : The gold is in Box 2

Only one message is true; the other two are false. Which box has the gold?

A. Box 1

B. Box 2

C. Both Boxes

D. Nether of the Boxes

E. It cannot be determined

17. There once was a king in a far off island who read , in which a prisoner must choose between two rooms, one containing a lady and the other a tiger. If he chooses the former, the prisoner marries the lady; while if he chooses the latter, he (probably) gets eaten by the tiger. The following signs placed on the two doors.There could be ladies in both rooms, tigers in both rooms, or a lady in one room and a tiger in the other. Additionally, the signs on the doors were either both true or both false.

    1. D1: Either a lady is in this room, or a tiger is in the other room.
    2. D2: A lady is in the other room.

    A. Door 1

    B. Either of these doors $D1 \vee D2$

    C. Door 2

    D. Cant determine, Prisoner needs more information.

18. In the Kripke model $\{W, R, V\}$, Let $W = \{i, j, k, l\}$, $R = \{(i, j), (j, k), (k, l), (k, i)\}$ and V is a valuation function defined as follows: $M, i \models p, q$ and $M, j \models q$ $M, k \models p$, $M, l \models \emptyset$ (emptyset). Which of the following formulas are valid in the model (You need to check the truth of the formula under all worlds (i,j,k,l).

    1. $\Diamond (p \wedge q) \rightarrow \Diamond p \wedge \Diamond q$.
    2. $\Diamond \Box p \vee \Diamond \Diamond \Box p$
    3. $\Box \Box \Diamond q$

    A. 1,2,3

    B. 1,3

    C. 2,3

    D. 3

    E. none of the above

Part III. Rough Work

Part III. Rough Work

Part I11. Rough Work