EXERCISE 1

[Chapter 1: Topological Spaces, Definitions and Examples]

Question I: (MCQ) Choose the correct answer (only one) for each of the following.

1. Which of the following families is a topology on $X = \{a, b, c, d\}$?	
(A) $\{X, \emptyset, \{a\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}\}$.	**(B)** $\{\emptyset, \{a\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}\}$.
(C) $\{X, \emptyset, \{a\}, \{c, d\}, \{a, c\}, \{b, c, d\}\}$.	**(D)** $\{X, \emptyset, \{a\}, \{a, c\}, \{b, c, d\}\}$.

2. Which of the following families is a topology on $X = [0, \infty)$?	
(A) $\{X, \emptyset, G \subset X: G \text{ is an infinite set}\}$.	**(B)** $\{X, \emptyset, G \subset X: G \text{ is a finite set}\}$.
(C) $\{X, \emptyset, (a, \infty): a \in X, a \geq 0\}$.	**(D)** $\{X, \emptyset, \{a\}: a \in X, a \geq 0\}$.

3. Which of the following families is a topology on $\mathbb{N}$?	
(A) $\{\emptyset, G \subset \mathbb{N}: G \text{ is an infinite set}\}$.	**(B)** $\{\mathbb{N}, G \subset \mathbb{N}: G \text{ is a finite set}\}$.
(C) $\{\mathbb{N}, \emptyset, \{1, 2, \ldots, n\}: n \in \mathbb{N}\}$.	**(D)** $\{\mathbb{N}, \emptyset, \{a\}: a \in \mathbb{N}\}$.

4. Which of the following families is a topology on $\mathbb{R}$?	
(A) $\{\mathbb{R}, \emptyset, (-r, r): r \in \mathbb{R}, r > 0\}$.	**(B)** $\{\mathbb{R}, G \subset \mathbb{R}: G \text{ is a finite set}\}$.
(C) $\{\emptyset, G \subset \mathbb{R}: G \text{ is an infinite set}\}$.	**(D)** $\{\mathbb{R}, \emptyset, \{a\}: a \in \mathbb{R}, a \geq 0\}$.

5. Which of the following families is the closed sets of a topology on $X = \{a, b, c, d\}$?	
(A) $\{X, \emptyset, \{a\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}\}$.	**(B)** $\{X, \{b, c, d\}, \{a, b\}, \{b\}, \{a\}\}$.
(C) $\{X, \emptyset, \{a\}, \{b, d\}, \{a, b\}, \{b, c, d\}\}$.	**(D)** $\{X, \emptyset, \{a\}, \{b, d\}, \{b, c, d\}\}$

6. Which of the following families is the closed sets of a topology on $X = [0, \infty)$?	
(A) $\{X, \emptyset, F \subset X: F^c \text{ is infinite set}\}$.	**(B)** $\{X, \emptyset, F \subset: F^c \text{ is a finite set}\}$.
(C) $\{X, \emptyset, [0, a]: a \in X, a > 0\}$.	**(D)** $\{X, \emptyset, [0, a) \cup (a, \infty): a \in X, a \geq 0\}$.

7. Which of the following families is the closed sets of a topology on $\mathbb{R}$?	
(A) $\{\mathbb{R}, \emptyset, (-\infty, -n) \cup (n, \infty): n \in \mathbb{N}\}$.	**(B)** $\{\mathbb{R}, \emptyset, F \subset: F^c \text{ is a finite set}\}$.
(C) $\{\mathbb{R}, \emptyset, F \subset \mathbb{R}: F^c \text{ is infinite set}\}$.	**(D)** $\{\mathbb{R}, \emptyset, (-\infty, a) \cup (a, \infty): a \geq 0\}$.

8. Which of the following families is the closed sets of a topology on $\mathbb{N}$?	
(A) $\{\mathbb{N}, F \subset \mathbb{N}: F^c \text{ is an infinite set}\}$.	**(B)** $\{\emptyset, F \subset \mathbb{N}: F^c \text{ is a finite set}\}$.
(C) $\{\mathbb{N}, \emptyset, \{n+1, n+2, \ldots\}: n \in \mathbb{N}\}$.	**(D)** $\{\mathbb{N}, \emptyset, \{a\}^c: a \in \mathbb{N}\}$.

9. Which of the following families is the closed sets of a topology on $\mathbb{R}$?	
(A) $\{\mathbb{R}, \emptyset, (-\infty, -r) \cup (r, \infty): r \in \mathbb{R}, r > 0\}$.	**(B)** $\{\emptyset, F \subset \mathbb{R}: F^c \text{ is a finite set}\}$.
(C) $\{\mathbb{R}, F \subset \mathbb{R}: F^c \text{ is an infinite set}\}$.	**(D)** $\{\mathbb{R}, \emptyset, \{a\}^c : a \geq 0\}$.

Questions 5 – 9 are canceled

10. In the co-finite space $(\mathbb{N}, \tau_f)$, the sets $\{1\}, \{5, 6, 7\}, \{2, 4, 6, 8\}$ are:	
(A) open, but not closed sets.	**(B) closed, but not open sets.**
(C) clopen sets.	**(D) neither open nor closed sets.**

11. In the co-finite space $(\mathbb{N}, \tau_f)$, the set $\{1, 3, 5, 7, 9, \ldots\}$ is:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

12. In the co-finite space $(\mathbb{N}, \tau_f)$, the set $\{2, 4, 6, \ldots\}$ *is*:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

13. In the co-finite space $(\mathbb{N}, \tau_f)$, the set $\{n: n \leq 10\}$ is:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

14. In the co-finite space $(\mathbb{N}, \tau_f)$, the set $\{n: n \geq 10\}$ is:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

15. In the indiscrete space $(\mathbb{N}, \mathcal{I})$, the sets $\{1\}, \{5,6,7\}, \{2,4,6,8\}$ are:	
(A) open, but not closed sets.	**(B) closed, but not open sets.**
(C) clopen sets.	**(D) neither open nor closed sets.**

16. In the indiscrete space $(\mathbb{N}, \mathcal{I})$, the set $\{1,3,5,7,9, \ldots\}$ is:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

17. In the indiscrete space $(\mathbb{N}, \mathcal{I})$, the set $\{2,4,6, \ldots\}$ *is*:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

18. In the indiscrete space $(\mathbb{N}, \mathcal{I})$, the set $\{n: n \leq 10\}$ is:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

19. In the indiscrete space $(\mathbb{N}, \mathcal{I})$, the set $\{n: n \geq 10\}$ is:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

20. In the discrete space $(\mathbb{N}, \mathcal{D})$, the sets $\{1\}, \{5,6,7\}, \{2,4,6,8\}$ are:	
(A) open, but not closed sets.	**(B) closed, but not open sets.**
(C) clopen sets.	**(D) neither open nor closed sets.**

21. In the discrete space $(\mathbb{N}, \mathcal{D})$, the set $\{1,3,5,7,9, \ldots\}$ is:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

22. In the discrete space $(\mathbb{N}, \mathcal{D})$, the set $\{2,4,6, \ldots\}$ *is*:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

23. In the discrete space $(\mathbb{N}, \mathcal{D})$, the set $\{n: n \leq 10\}$ is:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

24. In the discrete space $(\mathbb{N}, \mathcal{D})$, the set $\{n: n \geq 10\}$ is:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

25. In the co-finite space $(\mathbb{R}, \tau_f)$, the sets $\{1\}, \{5,6,7\}, \{2,4,6,8\}$ are:	
(A) open, but not closed sets.	**(B) closed, but not open sets.**
(C) clopen sets.	**(D) neither open nor closed sets.**

26. In the co-finite space $(\mathbb{R}, \tau_f)$, the set $\{1,3,5,7,9, \ldots\}$ is:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

27. In the co-finite space $(\mathbb{R}, \tau_f)$, the set $\{2,4,6, \ldots\}$ *is*:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

28. In the co-finite space $(\mathbb{R}, \tau_f)$, the set $\{a \in \mathbb{R}: a \leq 10\}$ is:	
(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

29. In the co-finite space $(\mathbb{R}, \tau_f)$, the set$\{a \in \mathbb{R}: a \geq 10\}$ is:

(A) open, but not closed set.	**(B) closed, but not open set.**
(C) clopen set.	**(D) neither open nor closed set.**

30. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{a\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

31. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{b\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

32. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{c\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

33. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{d\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

34. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

35. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{a, b\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

36. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{a, c\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

37. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{a, d\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

38. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{a, e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

39. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{b, c\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

40. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{b, d\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

41. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{b, e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

42. Let $\tau = \{X, \emptyset, \{b\}, \{d,e\}, \{b,d,e\}, \{a,c,d,e\}\}$ *be a topology on* $X = \{a,b,c,d,e\}$. In the space (X,τ): The set $A = \{c,d\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

43. Let $\tau = \{X, \emptyset, \{b\}, \{d,e\}, \{b,d,e\}, \{a,c,d,e\}\}$ *be a topology on* $X = \{a,b,c,d,e\}$. In the space (X,τ): The set $A = \{c,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

44. Let $\tau = \{X, \emptyset, \{b\}, \{d,e\}, \{b,d,e\}, \{a,c,d,e\}\}$ *be a topology on* $X = \{a,b,c,d,e\}$. In the space (X,τ): The set $A = \{d,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

45. Let $\tau = \{X, \emptyset, \{b\}, \{d,e\}, \{b,d,e\}, \{a,c,d,e\}\}$ *be a topology on* $X = \{a,b,c,d,e\}$. In the space (X,τ): The set $A = \{a,b,c\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

46. Let $\tau = \{X, \emptyset, \{b\}, \{d,e\}, \{b,d,e\}, \{a,c,d,e\}\}$ *be a topology on* $X = \{a,b,c,d,e\}$. In the space (X,τ): The set $A = \{a,b,d\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

47. Let $\tau = \{X, \emptyset, \{b\}, \{d,e\}, \{b,d,e\}, \{a,c,d,e\}\}$ *be a topology on* $X = \{a,b,c,d,e\}$. In the space (X,τ): The set $A = \{a,b,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

48. Let $\tau = \{X, \emptyset, \{b\}, \{d,e\}, \{b,d,e\}, \{a,c,d,e\}\}$ *be a topology on* $X = \{a,b,c,d,e\}$. In the space (X,τ): The set $A = \{a,c,d\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

49. Let $\tau = \{X, \emptyset, \{b\}, \{d,e\}, \{b,d,e\}, \{a,c,d,e\}\}$ *be a topology on* $X = \{a,b,c,d,e\}$. In the space (X,τ): The set $A = \{a,c,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

50. Let $\tau = \{X, \emptyset, \{b\}, \{d,e\}, \{b,d,e\}, \{a,c,d,e\}\}$ *be a topology on* $X = \{a,b,c,d,e\}$. In the space (X,τ): The set $A = \{a,d,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

51. Let $\tau = \{X, \emptyset, \{b\}, \{d,e\}, \{b,d,e\}, \{a,c,d,e\}\}$ *be a topology on* $X = \{a,b,c,d,e\}$. In the space (X,τ): The set $A = \{b,c,d\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

52. Let $\tau = \{X, \emptyset, \{b\}, \{d,e\}, \{b,d,e\}, \{a,c,d,e\}\}$ *be a topology on* $X = \{a,b,c,d,e\}$. In the space (X,τ): The set $A = \{b,c,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

53. Let $\tau = \{X, \emptyset, \{b\}, \{d,e\}, \{b,d,e\}, \{a,c,d,e\}\}$ *be a topology on* $X = \{a,b,c,d,e\}$. In the space (X,τ): The set $A = \{b,d,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

54. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{c, d, e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen*.	**(D) *Neither open nor closed.***

55. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{a, b, c, d\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen*.	**(D) *Neither open nor closed.***

56. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{a, b, c, e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen*.	**(D) *Neither open nor closed.***

57. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{a, b, d, e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen*.	**(D) *Neither open nor closed.***

58. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{a, c, d, e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen*.	**(D) *Neither open nor closed.***

59. Let $\tau = \{X, \emptyset, \{b\}, \{d, e\}, \{b, d, e\}, \{a, c, d, e\}\}$ *be a topology on* $X = \{a, b, c, d, e\}$. In the space (X, τ): The set $A = \{b, c, d, e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen*.	**(D) *Neither open nor closed.***

60. Let $\tau = \{X, \emptyset, \{a\}, \{c, d\}, \{a, c, d\}, \{b, c, d, e, f\}\}$ *be a topology on* $X = \{a, b, c, d, e, f\}$. In the space (X, τ): The set $A = \{a\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen*.	**(D) *Neither open nor closed.***

61. Let $\tau = \{X, \emptyset, \{a\}, \{c, d\}, \{a, c, d\}, \{b, c, d, e, f\}\}$ *be a topology on* $X = \{a, b, c, d, e, f\}$. In the space (X, τ): The set $A = \{b\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen*.	**(D) *Neither open nor closed.***

62. Let $\tau = \{X, \emptyset, \{a\}, \{c, d\}, \{a, c, d\}, \{b, c, d, e, f\}\}$ *be a topology on* $X = \{a, b, c, d, e, f\}$. In the space (X, τ): The set $A = \{c\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen*.	**(D) *Neither open nor closed.***

63. Let $\tau = \{X, \emptyset, \{a\}, \{c, d\}, \{a, c, d\}, \{b, c, d, e, f\}\}$ *be a topology on* $X = \{a, b, c, d, e, f\}$. In the space (X, τ): The set $A = \{d\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen*.	**(D) *Neither open nor closed.***

64. Let $\tau = \{X, \emptyset, \{a\}, \{c, d\}, \{a, c, d\}, \{b, c, d, e, f\}\}$ *be a topology on* $X = \{a, b, c, d, e, f\}$. In the space (X, τ): The set $A = \{e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen*.	**(D) *Neither open nor closed.***

65. Let $\tau = \{X, \emptyset, \{a\}, \{c, d\}, \{a, c, d\}, \{b, c, d, e, f\}\}$ *be a topology on* $X = \{a, b, c, d, e, f\}$. In the space (X, τ): The set $A = \{f\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen*.	**(D) *Neither open nor closed.***

66. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,b\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

67. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,c\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

68. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,d\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

69. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,e\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

70. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,f\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

71. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{b,c\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

72. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{b,d\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

73. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{b,e\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

74. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{b,f\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

75. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{c,d\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

76. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{c,e\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

77. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{c,f\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

78. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{d,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

79. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{d,f\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

80. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,b,c\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

81. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,b,d\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

82. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,b,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

83. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,b,f\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

84. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,c,d\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

85. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,c,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

86. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,c,f\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

87. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,d,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

88. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,d,f\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

89. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,e,f\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

90. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{b,c,d\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

91. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{b,c,e\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

92. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{b,c,f\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

93. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{b,d,e\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

94. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{b,e,f\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

95. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{c,d,e\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

96. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{c,d,f\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

97. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{d,e,f\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

98. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,b,c,d\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

99. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,b,c,e\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

100. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,b,c,f\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

101. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ be a topology on $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,b,d,e\}$ is:	
(A) Open but not closed.	**(B) Closed but not open.**
(C) Clopen.	**(D) Neither open nor closed.**

102. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,b,d,f\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

103. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,c,d,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

104. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{a,c,d,f\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

105. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{b,c,d,e\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

106. Let $\tau = \{X, \emptyset, \{a\}, \{c,d\}, \{a,c,d\}, \{b,c,d,e,f\}\}$ *be a topology on* $X = \{a,b,c,d,e,f\}$. In the space (X,τ): The set $A = \{b,c,d,f\}$ *is*:	
(A) *Open but not closed.*	**(B) *Closed but not open.***
(C) *Clopen.*	**(D) *Neither open nor closed.***

Question II: (TRUE OR FALSE) **Put (T) for true statement and (F) for false statement.**

Let $X = \{a,b,c,d\}$ *and* $\mathcal{D}$ *be the discrete topology on* X. Determine, for each of the following statements, whether it is TRUE or FALSE.	
1. $X \in \mathcal{D}$.	**2. $\{\emptyset\} \in \mathcal{D}$.**
3. $\emptyset \in \mathcal{D}$.	**4. $\emptyset \in X$.**
5. $\{a\} \in \mathcal{D}$.	

Let $X = \{a,b,c,d\}$ *and* $\mathcal{I}$ *be the indiscrete topology on* X. Determine, for each of the following statements, whether it is TRUE or FALSE.	
6. $X \in \mathcal{I}$.	**7. $\{\emptyset\} \in \mathcal{I}$.**
8. $\emptyset \in \mathcal{I}$.	**9. $\emptyset \in X$**
10. $\{a\} \in \mathcal{I}$.	

Consider the co-finite space $(\mathbb{R}, \tau_f)$. Determine, for each of the following statements, whether it is TRUE or FALSE.	
11. $(1,3) \in \tau_f$.	**12. $(1,3) \cup (5,6) \in \tau_f$.**
13. $\{1,2\} \notin \tau_f^*$.	**14. $\{1,2\} \in \tau_f^*$.**
15. $(1,3) \cap (5,6) \in \tau_f$.	

Consider the co-finite space $(\mathbb{N}, \tau_f)$. Determine, for each of the following statements, whether it is TRUE or FALSE.	
16. The set $\{n \in \mathbb{N}: n \geq 10\}$ is an open set, but not a closed set.	**17. The set $\{n \in \mathbb{N}: n \geq 10\}$ is a clopen set.**
18. The set $\{n \in \mathbb{N}: n \geq 10\}$ is a closed set, but not an open set.	**19. The set $\{n \in \mathbb{N}: n \geq 10\}$ is neither an open set, nor a closed set.**
20. The set $\{1,3,5,7,\ldots\}$ is an open set, but not a closed set.	**21. The set $\{1,3,5,7,\ldots\}$ is a closed set, but not an open set.**
22. The set $\{1,3,5,7,\ldots\}$ is a clopen set.	**23. The set $\{1,3,5,7,\ldots\}$ is neither an open set, nor a closed set.**

24. The set $\{2,4,6,\dots\}$ is an open set, but not a closed set.	**25. The set $\{2,4,6,\dots\}$ is a closed set, but not an open set.**
26. The set $\{2,4,6,\dots\}$ is a clopen set.	**27. The set $\{2,4,6,\dots\}$ is neither an open set, nor a closed set.**
28. The set $\{1,2,7,8,9,\dots\}$ is an open set, but not a closed set.	**29. The set $\{1,2,7,8,9,\dots\}$is a a closed set, but not an open set.**
30. The set $\{1,2,7,8,9,\dots\}$ is a clopen set.	**31. The set $\{1,2,7,8,9,\dots\}$ is neither an open set, nor a closed set.**
32. The set $\{n \in \mathbb{N}: n \leq 10\}$ is an open set, but not a closed set.	**33. The set $\{n \in \mathbb{N}: n \leq 10\}$ is a clopen set.**
34. The set $\{n \in \mathbb{N}: n \leq 10\}$ is a closed set, but not an open set .	**35. The set $\{n \in \mathbb{N}: n \leq 10\}$ is neither an open set, nor a closed set.**

<u>Question III: (MATCHING)</u> From the following table, match each part from column (a) to the suitable apart (only one) from column (b) to make a true statement.

Column (a)		Column (b)	
1	In $(\mathbb{R}, \tau_f)$	A	$all\ subsets\ of\ X\ are\ clopen\ sets.$
2	$If\ (X,\tau_f)\ has\ 3\ distinct\ clopen\ subsets, then$	B	$\tau_f{}^* = \{\mathbb{R}, F \subset \mathbb{R}: F\ is\ a\ finite\ set\}$
3	In $(X,\tau), if\ \tau = \mathcal{I}, then$	C	$\tau = \tau^* = \{X, \emptyset\}$
4	In $(X,\tau), if\ \tau = \mathcal{D}, then$	D	X is a finite set and $\tau_f = \mathcal{D}$.

ANSWER OF QUESTION I (MCQ)

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Answer	A			A	=	=	=	=	=	B			B			D

Question	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Answer	D			C			C			D			D			D

Question	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Answer	D			B			D			D			B			D

Question	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
Answer	D			D			D			C			D			D

Question	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Answer	D			D			D			D			D			D

Question	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
Answer	D			D			D			D			D			D

Question	97	98	99	100	101	102	103	104	105	106						
Answer	D			D			D			D						

Questions 5 – 9 are canceled

ANSWER OF QUESTION II (T/F)

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Answer	T			F			F			F			F			T

Question	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Answer	F			F			T			F			F			F

ANSWER OF QUESTION III (MACHING)

Question	1	2	3	4												
Answer	B			A												