```
Training for CA_4
Single window of past history : (100, 4)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 116ms/step - loss: 0.7270 - val_loss: 1.0209
Epoch 2/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6942 - val_loss: 0.9305
Epoch 3/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6422 - val_loss: 0.8073
Epoch 4/100
50/50 [==============================] - 5s 103ms/step - loss: 0.5881 - val_loss: 0.7027
Epoch 5/100
50/50 [==============================] - 5s 102ms/step - loss: 0.5555 - val_loss: 0.6456
Epoch 6/100
50/50 [==============================] - 5s 100ms/step - loss: 0.5356 - val_loss: 0.6301
Epoch 7/100
50/50 [==============================] - 5s 100ms/step - loss: 0.5220 - val_loss: 0.6051
Epoch 8/100
50/50 [==============================] - 5s 108ms/step - loss: 0.5166 - val_loss: 0.5914
Epoch 9/100
50/50 [==============================] - 6s 115ms/step - loss: 0.5142 - val_loss: 0.5858
Epoch 10/100
50/50 [==============================] - 5s 108ms/step - loss: 0.5134 - val_loss: 0.5795
Epoch 11/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5112 - val_loss: 0.5767
Epoch 12/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5106 - val_loss: 0.5758
Epoch 13/100
50/50 [==============================] - 5s 105ms/step - loss: 0.5098 - val_loss: 0.5715
Epoch 14/100
50/50 [==============================] - 5s 105ms/step - loss: 0.5093 - val_loss: 0.5719
Epoch 15/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5079 - val_loss: 0.5698
Epoch 16/100
50/50 [==============================] - 5s 105ms/step - loss: 0.5075 - val_loss: 0.5680
Epoch 17/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5062 - val_loss: 0.5677
Epoch 18/100
50/50 [==============================] - 5s 105ms/step - loss: 0.5056 - val_loss: 0.5653
Epoch 19/100
50/50 [==============================] - 5s 101ms/step - loss: 0.5048 - val_loss: 0.5654
Epoch 20/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5040 - val_loss: 0.5615
Epoch 21/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5034 - val_loss: 0.5601
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Epoch 22/100
50/50 [==============================] - 5s 105ms/step - loss: 0.5027 - val_loss: 0.5562
Epoch 23/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4993 - val_loss: 0.5542
Epoch 24/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5008 - val_loss: 0.5504
Epoch 25/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4969 - val_loss: 0.5476
Epoch 26/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4945 - val_loss: 0.5436
Epoch 27/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4902 - val_loss: 0.5375
Epoch 28/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4841 - val_loss: 0.5528
Epoch 29/100
50/50 [==============================] - 5s 100ms/step - loss: 0.4726 - val_loss: 0.5030
Epoch 30/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4560 - val_loss: 0.4642
Epoch 31/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4349 - val_loss: 0.4523
Epoch 32/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4760 - val_loss: 0.4481
Epoch 33/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4272 - val_loss: 0.4394
Epoch 34/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4008 - val_loss: 0.4061
Epoch 35/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3822 - val_loss: 0.3922
Epoch 36/100
50/50 [==============================] - 5s 99ms/step - loss: 0.3719 - val_loss: 0.3780
Epoch 37/100
50/50 [==============================] - 5s 99ms/step - loss: 0.3658 - val_loss: 0.3736
Epoch 38/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3633 - val_loss: 0.3802
Epoch 39/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3580 - val_loss: 0.3739
Epoch 40/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3558 - val_loss: 0.3708
Epoch 41/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3527 - val_loss: 0.3705
Epoch 42/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3527 - val_loss: 0.3726
Epoch 43/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3500 - val_loss: 0.3728
Epoch 44/100
```

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50/50 [==============================] - 5s 107ms/step - loss: 0.3479 - val_loss: 0.3756
Epoch 45/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3461 - val_loss: 0.3756
Epoch 46/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3542 - val_loss: 0.3686
Epoch 47/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3430 - val_loss: 0.3744
Epoch 48/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3430 - val_loss: 0.3721
Epoch 49/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3438 - val_loss: 0.3695
Epoch 50/100
50/50 [==============================] - 6s 123ms/step - loss: 0.3411 - val_loss: 0.3694
Epoch 51/100
50/50 [==============================] - 7s 147ms/step - loss: 0.3385 - val_loss: 0.3782
Epoch 52/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3401 - val_loss: 0.3781
Epoch 53/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3391 - val_loss: 0.3782
Epoch 54/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3364 - val_loss: 0.3747
Epoch 55/100
50/50 [==============================] - 5s 100ms/step - loss: 0.3362 - val_loss: 0.3742
Epoch 56/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3358 - val_loss: 0.3692
Epoch 57/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3337 - val_loss: 0.3746
Epoch 58/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3341 - val_loss: 0.3840
Epoch 59/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3335 - val_loss: 0.3827
Epoch 60/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3325 - val_loss: 0.3763
Epoch 61/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3302 - val_loss: 0.3761
Epoch 62/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3302 - val_loss: 0.3786
Epoch 63/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3299 - val_loss: 0.3919
Epoch 64/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3290 - val_loss: 0.3991
Epoch 65/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3286 - val_loss: 0.3939
Epoch 66/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3275 - val_loss: 0.3919
```

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Epoch 67/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3257 - val_loss: 0.3896
Epoch 68/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3259 - val_loss: 0.4003
Epoch 69/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3249 - val_loss: 0.4047
Epoch 70/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3233 - val_loss: 0.4104
Epoch 71/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3213 - val_loss: 0.4149
Epoch 72/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3228 - val_loss: 0.3997
Epoch 73/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3213 - val_loss: 0.4134
Epoch 74/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3200 - val_loss: 0.4020
Epoch 75/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3187 - val_loss: 0.4120
Epoch 76/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3175 - val_loss: 0.3987
Epoch 77/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3180 - val_loss: 0.4135
Epoch 78/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3165 - val_loss: 0.4384
Epoch 79/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3155 - val_loss: 0.4152
Epoch 80/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3137 - val_loss: 0.4366
Epoch 81/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3143 - val_loss: 0.4299
Epoch 82/100
50/50 [==============================] - 5s 100ms/step - loss: 0.3122 - val_loss: 0.4297
Epoch 83/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3126 - val_loss: 0.4172
Epoch 84/100
50/50 [==============================] - 6s 127ms/step - loss: 0.3124 - val_loss: 0.4422
Epoch 85/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3094 - val_loss: 0.4539
Epoch 86/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3089 - val_loss: 0.4633
Epoch 87/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3101 - val_loss: 0.4483
Epoch 88/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3090 - val_loss: 0.4454
Epoch 89/100
```

50/50 [==============================] - 5s 103ms/step - loss: 0.3073 - val_loss: 0.4587
Epoch 90/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3069 - val_loss: 0.4622
Epoch 91/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3062 - val_loss: 0.4545
Epoch 92/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3058 - val_loss: 0.4734
Epoch 93/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3052 - val_loss: 0.4760
Epoch 94/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3044 - val_loss: 0.4827
Epoch 95/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3042 - val_loss: 0.4873
Epoch 96/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3021 - val_loss: 0.4920
Epoch 97/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3035 - val_loss: 0.4711
Epoch 98/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3017 - val_loss: 0.4858
Epoch 99/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3023 - val_loss: 0.4583
Epoch 100/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3015 - val_loss: 0.4841

Multi-Step Training and validation loss for CA_4

Multi_step LSTM for CA_4

Tail of Multi_step LSTM for CA_4
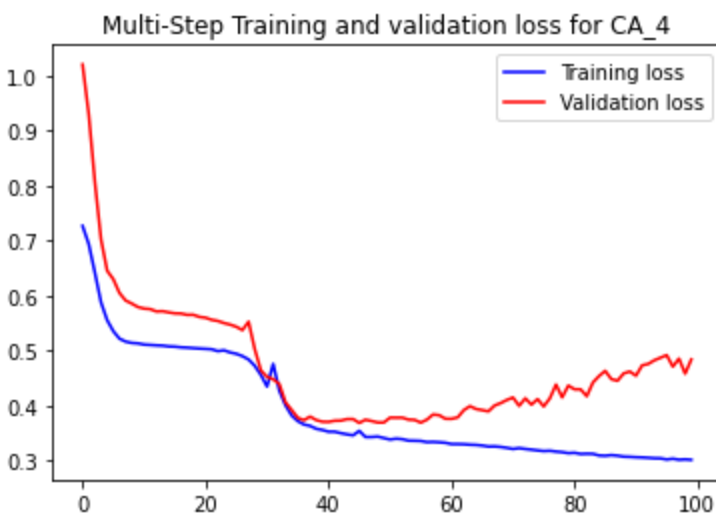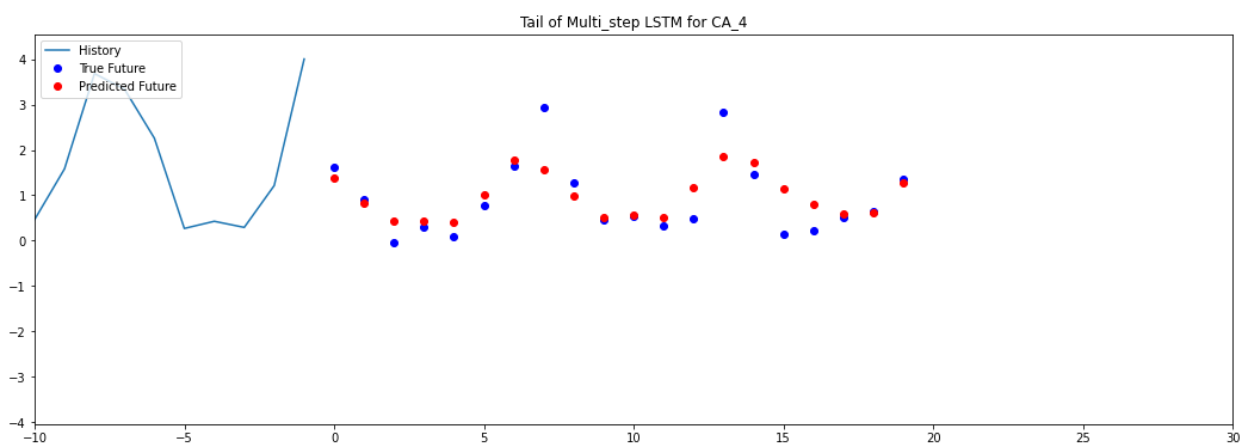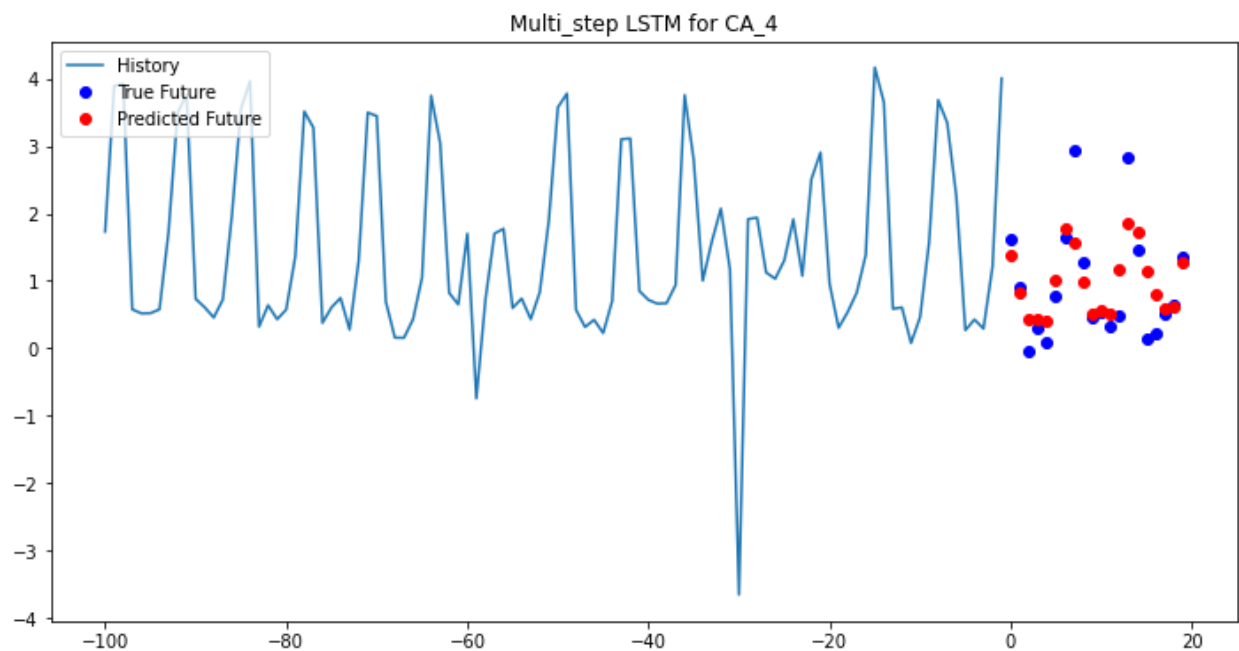
CA_4 - True Future: [2787. 2487. 2088. 2239. 2153. 2432. 2806. 3343. 2643. 2299. 2335. 2244.
 2316. 3301. 2727. 2166. 2207. 2323. 2383. 2677.]
CA_4 - Model Prediction: [2694.7803 2457.9932 2292.651 2295.1565 2280.5989 2531.103
2853.4912
 2773.8975 2522.1047 2327.5168 2352.389 2320.9082 2603.2878 2885.5923
 2834.8757 2592.9675 2447.9985 2358.271 2373.3704 2646.327]
CA_4 - Model Percentage Error: [3.30892453 1.1663384   9.8012873   2.50810604 5.92656186
4.07496001
  1.69248792 17.02370742 4.57416813 1.24040216 0.74470732 3.42728178
 12.40448367 12.58429915 3.95583911 19.71225897 10.91973426 1.51833819
  0.4040973   1.14580111]%
CA_4 - Model Mean Percentage Error: 5.906689230953762%
===================================
===================================
Training for CA_2

```
Single window of past history : (100, 4)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 115ms/step - loss: 0.7871 - val_loss: 1.8079
Epoch 2/100
50/50 [==============================] - 6s 114ms/step - loss: 0.7681 - val_loss: 1.7419
Epoch 3/100
50/50 [==============================] - 5s 105ms/step - loss: 0.7448 - val_loss: 1.5361
Epoch 4/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7205 - val_loss: 1.3586
Epoch 5/100
50/50 [==============================] - 5s 103ms/step - loss: 0.7018 - val_loss: 1.2645
Epoch 6/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6898 - val_loss: 1.1872
Epoch 7/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6817 - val_loss: 1.1437
Epoch 8/100
50/50 [==============================] - 5s 102ms/step - loss: 0.6753 - val_loss: 1.1273
Epoch 9/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6727 - val_loss: 1.1082
Epoch 10/100
50/50 [==============================] - 6s 112ms/step - loss: 0.6700 - val_loss: 1.1039
Epoch 11/100
50/50 [==============================] - 6s 110ms/step - loss: 0.6682 - val_loss: 1.0953
Epoch 12/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6639 - val_loss: 1.0915
Epoch 13/100
50/50 [==============================] - 6s 117ms/step - loss: 0.6588 - val_loss: 1.0890
Epoch 14/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6524 - val_loss: 1.0869
Epoch 15/100
50/50 [==============================] - 6s 115ms/step - loss: 0.6523 - val_loss: 1.1010
Epoch 16/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6305 - val_loss: 1.1151
Epoch 17/100
50/50 [==============================] - 6s 111ms/step - loss: 0.5845 - val_loss: 1.0045
Epoch 18/100
50/50 [==============================] - 5s 108ms/step - loss: 0.5118 - val_loss: 0.9427
Epoch 19/100
50/50 [==============================] - 6s 115ms/step - loss: 0.4480 - val_loss: 0.8420
Epoch 20/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4092 - val_loss: 0.7932
Epoch 21/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3899 - val_loss: 0.7581
Epoch 22/100
```

```
50/50 [==============================] - 6s 118ms/step - loss: 0.3811 - val_loss: 0.7256
Epoch 23/100
50/50 [==============================] - 6s 120ms/step - loss: 0.3744 - val_loss: 0.7232
Epoch 24/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3712 - val_loss: 0.7025
Epoch 25/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3639 - val_loss: 0.7365
Epoch 26/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3567 - val_loss: 0.6830
Epoch 27/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3470 - val_loss: 0.6677
Epoch 28/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3379 - val_loss: 0.6422
Epoch 29/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3286 - val_loss: 0.6411
Epoch 30/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3215 - val_loss: 0.6247
Epoch 31/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3107 - val_loss: 0.7473
Epoch 32/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3066 - val_loss: 0.6710
Epoch 33/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3058 - val_loss: 0.5991
Epoch 34/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3001 - val_loss: 0.6750
Epoch 35/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2945 - val_loss: 0.5947
Epoch 36/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2918 - val_loss: 0.5935
Epoch 37/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2897 - val_loss: 0.6370
Epoch 38/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3168 - val_loss: 0.6430
Epoch 39/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2833 - val_loss: 0.5920
Epoch 40/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2937 - val_loss: 0.5673
Epoch 41/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2777 - val_loss: 0.5720
Epoch 42/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2835 - val_loss: 0.5526
Epoch 43/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3826 - val_loss: 1.0580
Epoch 44/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3678 - val_loss: 0.5842
```

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Epoch 45/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2761 - val_loss: 0.5595
Epoch 46/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2730 - val_loss: 0.5537
Epoch 47/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2710 - val_loss: 0.5731
Epoch 48/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2830 - val_loss: 0.5477
Epoch 49/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2686 - val_loss: 0.5405
Epoch 50/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2686 - val_loss: 0.5299
Epoch 51/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2663 - val_loss: 0.5611
Epoch 52/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2783 - val_loss: 0.5401
Epoch 53/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2652 - val_loss: 0.5379
Epoch 54/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2647 - val_loss: 0.5321
Epoch 55/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2633 - val_loss: 0.5412
Epoch 56/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2636 - val_loss: 0.6039
Epoch 57/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4324 - val_loss: 1.1060
Epoch 58/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6365 - val_loss: 1.0686
Epoch 59/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5691 - val_loss: 0.8332
Epoch 60/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3112 - val_loss: 0.5821
Epoch 61/100
50/50 [==============================] - 7s 147ms/step - loss: 0.2723 - val_loss: 0.5534
Epoch 62/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2651 - val_loss: 0.5409
Epoch 63/100
50/50 [==============================] - 5s 100ms/step - loss: 0.2622 - val_loss: 0.5315
Epoch 64/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2577 - val_loss: 0.5265
Epoch 65/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2585 - val_loss: 0.5417
Epoch 66/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2567 - val_loss: 0.5334
Epoch 67/100
```

```
50/50 [==============================] - 5s 106ms/step - loss: 0.2554 - val_loss: 0.5132
Epoch 68/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2537 - val_loss: 0.5259
Epoch 69/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2533 - val_loss: 0.5160
Epoch 70/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2520 - val_loss: 0.5024
Epoch 71/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2524 - val_loss: 0.5030
Epoch 72/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2507 - val_loss: 0.4954
Epoch 73/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2503 - val_loss: 0.5052
Epoch 74/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2499 - val_loss: 0.4993
Epoch 75/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2483 - val_loss: 0.4909
Epoch 76/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2494 - val_loss: 0.4982
Epoch 77/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2468 - val_loss: 0.4946
Epoch 78/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2467 - val_loss: 0.5019
Epoch 79/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2458 - val_loss: 0.4907
Epoch 80/100
50/50 [==============================] - 6s 110ms/step - loss: 0.2449 - val_loss: 0.4847
Epoch 81/100
50/50 [==============================] - 5s 101ms/step - loss: 0.2459 - val_loss: 0.4830
Epoch 82/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2437 - val_loss: 0.4874
Epoch 83/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2454 - val_loss: 0.4802
Epoch 84/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2414 - val_loss: 0.4777
Epoch 85/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2439 - val_loss: 0.4773
Epoch 86/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4170 - val_loss: 1.0833
Epoch 87/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6326 - val_loss: 1.0547
Epoch 88/100
50/50 [==============================] - 5s 110ms/step - loss: 0.5093 - val_loss: 0.7654
Epoch 89/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2739 - val_loss: 0.5511
```

```
Epoch 90/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2523 - val_loss: 0.5208
Epoch 91/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2469 - val_loss: 0.5094
Epoch 92/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2465 - val_loss: 0.4993
Epoch 93/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2426 - val_loss: 0.4882
Epoch 94/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2428 - val_loss: 0.4942
Epoch 95/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2406 - val_loss: 0.4910
Epoch 96/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2394 - val_loss: 0.4850
Epoch 97/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2391 - val_loss: 0.4773
Epoch 98/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2396 - val_loss: 0.4771
Epoch 99/100
50/50 [==============================] - 5s 100ms/step - loss: 0.2384 - val_loss: 0.4770
Epoch 100/100
50/50 [==============================] - 5s 100ms/step - loss: 0.2359 - val_loss: 0.4799
```


Multi-Step Training and validation loss for CA_2

Multi_step LSTM for CA_2

Tail of Multi_step LSTM for CA_2
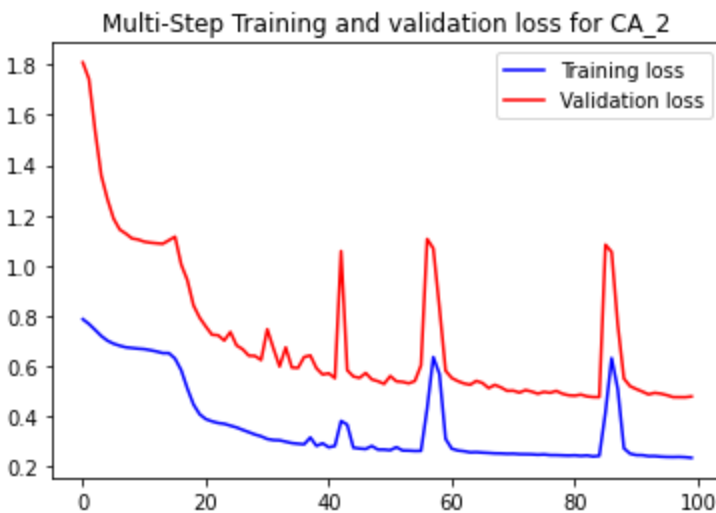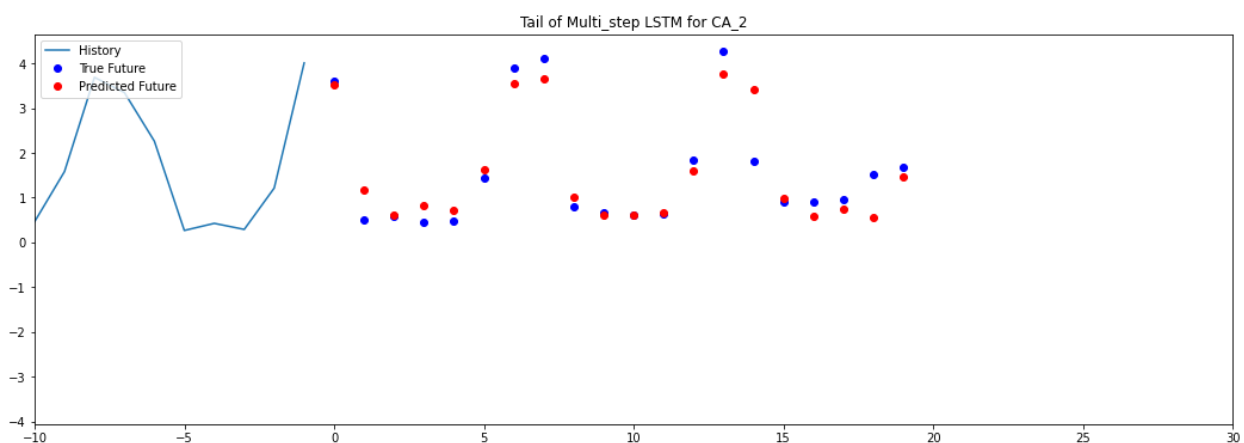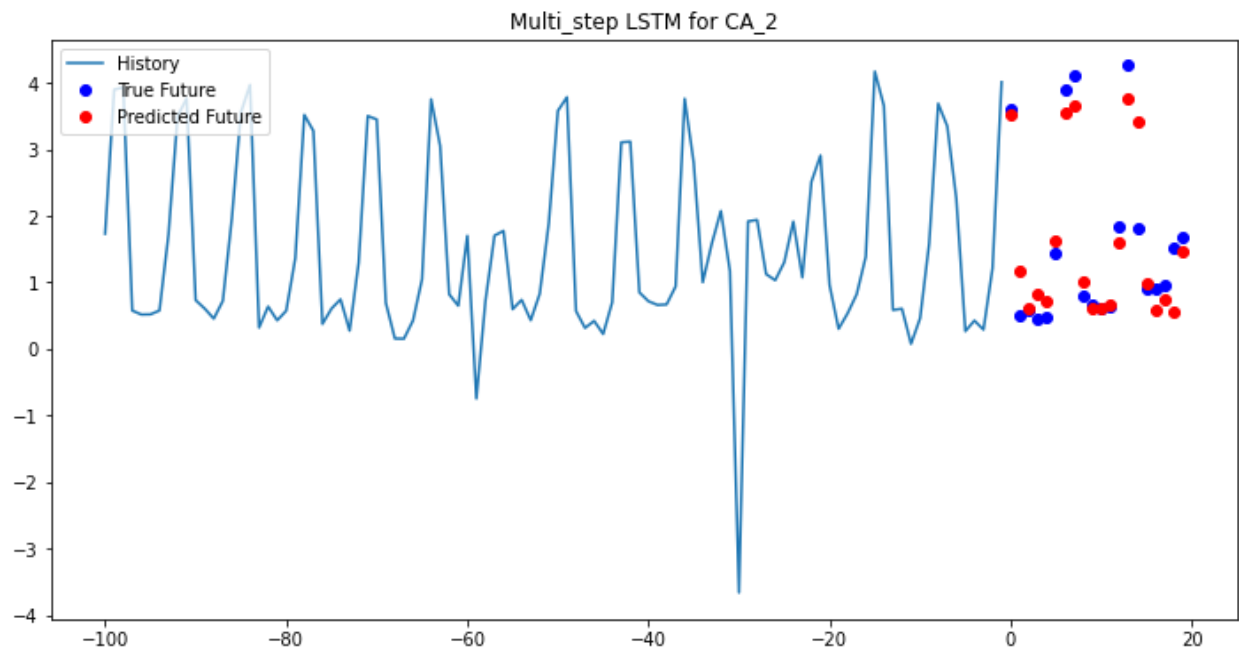
CA_2 - True Future: [5647. 3240. 3294. 3189. 3211. 3964. 5873. 6037. 3454. 3360. 3314. 3333. 4276. 6150. 4251. 3537. 3549. 3586. 4026. 4140.]

CA_2 - Model Prediction: [5586.743 3761.02   3326.7595 3479.4365 3405.6704 4104.3022 5602.4336
 5688.586 3627.6284 3319.1604 3309.5493 3357.2178 4078.7026 5770.5767
 5490.0767 3614.5308 3300.8223 3426.7073 3285.8237 3986.285]

CA_2 - Model Percentage Error: [1.06705925 16.0808648   0.99452099 9.10744821 6.0626101
 3.53941085
 4.60695396 5.77131129 5.0268795   1.21546427 0.13429944 0.72660586
 4.61406369 6.1694852 29.14788662 2.19199213 6.99289192 4.44207263
 18.38490486 3.71292483]%

CA_2 - Model Mean Percentage Error: 6.49948252079723%

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Training for CA_3

Single window of past history : (100, 4)
(72, 20)
Epoch 1/100
50/50 [==============================] - 5s 109ms/step - loss: 0.7264 - val_loss: 0.6568
Epoch 2/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6901 - val_loss: 0.6479
Epoch 3/100
50/50 [==============================] - 5s 102ms/step - loss: 0.6539 - val_loss: 0.6408
Epoch 4/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6357 - val_loss: 0.6363
Epoch 5/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6260 - val_loss: 0.6362
Epoch 6/100
50/50 [==============================] - 5s 100ms/step - loss: 0.6213 - val_loss: 0.6381
Epoch 7/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6180 - val_loss: 0.6397
Epoch 8/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6163 - val_loss: 0.6413
Epoch 9/100
50/50 [==============================] - 6s 112ms/step - loss: 0.6146 - val_loss: 0.6422
Epoch 10/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6131 - val_loss: 0.6423
Epoch 11/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6121 - val_loss: 0.6411
Epoch 12/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6103 - val_loss: 0.6409
Epoch 13/100
50/50 [==============================] - 5s 102ms/step - loss: 0.6097 - val_loss: 0.6396
Epoch 14/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6087 - val_loss: 0.6386
Epoch 15/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6065 - val_loss: 0.6372
Epoch 16/100
50/50 [==============================] - 5s 101ms/step - loss: 0.6065 - val_loss: 0.6363
Epoch 17/100
50/50 [==============================] - 5s 102ms/step - loss: 0.6041 - val_loss: 0.6347
Epoch 18/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6036 - val_loss: 0.6336
Epoch 19/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6021 - val_loss: 0.6331
Epoch 20/100
50/50 [==============================] - 5s 105ms/step - loss: 0.5998 - val_loss: 0.6322
Epoch 21/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5988 - val_loss: 0.6300
Epoch 22/100

```
50/50 [==============================] - 5s 104ms/step - loss: 0.5955 - val_loss: 0.6288
Epoch 23/100
50/50 [==============================] - 5s 103ms/step - loss: 0.5936 - val_loss: 0.6270
Epoch 24/100
50/50 [==============================] - 5s 101ms/step - loss: 0.5902 - val_loss: 0.6249
Epoch 25/100
50/50 [==============================] - 5s 103ms/step - loss: 0.5849 - val_loss: 0.6215
Epoch 26/100
50/50 [==============================] - 5s 103ms/step - loss: 0.5792 - val_loss: 0.6145
Epoch 27/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5699 - val_loss: 0.6047
Epoch 28/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5543 - val_loss: 0.5890
Epoch 29/100
50/50 [==============================] - 5s 104ms/step - loss: 0.5212 - val_loss: 0.5367
Epoch 30/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4883 - val_loss: 0.4920
Epoch 31/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4567 - val_loss: 0.4535
Epoch 32/100
50/50 [==============================] - 5s 100ms/step - loss: 0.4235 - val_loss: 0.4108
Epoch 33/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4103 - val_loss: 0.4078
Epoch 34/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3992 - val_loss: 0.3902
Epoch 35/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3928 - val_loss: 0.4084
Epoch 36/100
50/50 [==============================] - 5s 100ms/step - loss: 0.3879 - val_loss: 0.3735
Epoch 37/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3821 - val_loss: 0.3715
Epoch 38/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3781 - val_loss: 0.3730
Epoch 39/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3755 - val_loss: 0.3754
Epoch 40/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3732 - val_loss: 0.3820
Epoch 41/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3676 - val_loss: 0.3807
Epoch 42/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3651 - val_loss: 0.3736
Epoch 43/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3627 - val_loss: 0.3798
Epoch 44/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3617 - val_loss: 0.3673
```

```
Epoch 45/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3590 - val_loss: 0.3525
Epoch 46/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3544 - val_loss: 0.3601
Epoch 47/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3542 - val_loss: 0.3537
Epoch 48/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3525 - val_loss: 0.3396
Epoch 49/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3501 - val_loss: 0.3516
Epoch 50/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3483 - val_loss: 0.3400
Epoch 51/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3452 - val_loss: 0.3495
Epoch 52/100
50/50 [==============================] - 6s 128ms/step - loss: 0.3447 - val_loss: 0.3527
Epoch 53/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3411 - val_loss: 0.3373
Epoch 54/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3382 - val_loss: 0.3401
Epoch 55/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3412 - val_loss: 0.3383
Epoch 56/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3329 - val_loss: 0.3206
Epoch 57/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3319 - val_loss: 0.3268
Epoch 58/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3267 - val_loss: 0.3275
Epoch 59/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3318 - val_loss: 0.3181
Epoch 60/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3217 - val_loss: 0.3148
Epoch 61/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3249 - val_loss: 0.3179
Epoch 62/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3231 - val_loss: 0.3357
Epoch 63/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3145 - val_loss: 0.3086
Epoch 64/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3130 - val_loss: 0.3130
Epoch 65/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3101 - val_loss: 0.3813
Epoch 66/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3109 - val_loss: 0.3222
Epoch 67/100
```

```
50/50 [==============================] - 5s 104ms/step - loss: 0.3083 - val_loss: 0.3204
Epoch 68/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3054 - val_loss: 0.3343
Epoch 69/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3061 - val_loss: 0.3131
Epoch 70/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3056 - val_loss: 0.3014
Epoch 71/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3007 - val_loss: 0.3443
Epoch 72/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3022 - val_loss: 0.3072
Epoch 73/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2990 - val_loss: 0.3119
Epoch 74/100
50/50 [==============================] - 8s 156ms/step - loss: 0.3002 - val_loss: 0.2996
Epoch 75/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2974 - val_loss: 0.3354
Epoch 76/100
50/50 [==============================] - 6s 112ms/step - loss: 0.2951 - val_loss: 0.3271
Epoch 77/100
50/50 [==============================] - 6s 110ms/step - loss: 0.2959 - val_loss: 0.3168
Epoch 78/100
50/50 [==============================] - 6s 113ms/step - loss: 0.2995 - val_loss: 0.3211
Epoch 79/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2925 - val_loss: 0.3113
Epoch 80/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2931 - val_loss: 0.3173
Epoch 81/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2909 - val_loss: 0.3021
Epoch 82/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2949 - val_loss: 0.3088
Epoch 83/100
50/50 [==============================] - 6s 112ms/step - loss: 0.2888 - val_loss: 0.3143
Epoch 84/100
50/50 [==============================] - 6s 110ms/step - loss: 0.2893 - val_loss: 0.3300
Epoch 85/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2880 - val_loss: 0.3236
Epoch 86/100
50/50 [==============================] - 5s 101ms/step - loss: 0.2884 - val_loss: 0.3244
Epoch 87/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2871 - val_loss: 0.3332
Epoch 88/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2864 - val_loss: 0.3264
Epoch 89/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2862 - val_loss: 0.3334
```

```
Epoch 90/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3104 - val_loss: 0.3411
Epoch 91/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2837 - val_loss: 0.3426
Epoch 92/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2846 - val_loss: 0.3170
Epoch 93/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2826 - val_loss: 0.3291
Epoch 94/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2825 - val_loss: 0.3156
Epoch 95/100
50/50 [==============================] - 6s 112ms/step - loss: 0.2820 - val_loss: 0.3290
Epoch 96/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2818 - val_loss: 0.3226
Epoch 97/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2800 - val_loss: 0.3352
Epoch 98/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2824 - val_loss: 0.3449
Epoch 99/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2782 - val_loss: 0.3540
Epoch 100/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2791 - val_loss: 0.3637
```


Multi-Step Training and validation loss for CA_3

Multi_step LSTM for CA_3

Tail of Multi_step LSTM for CA_3
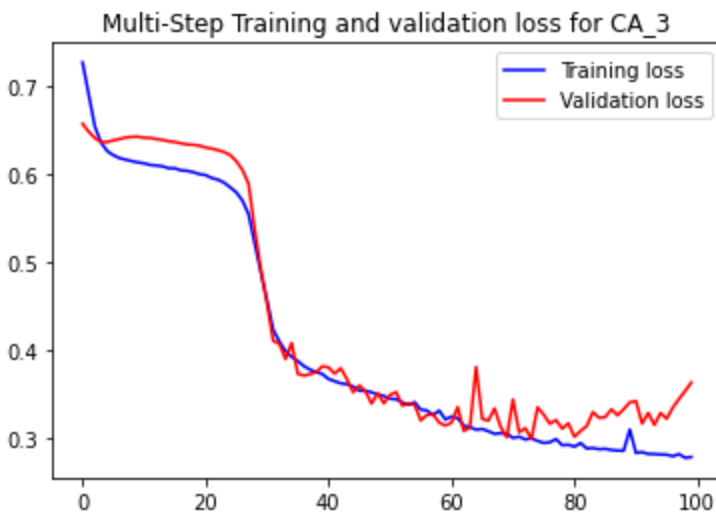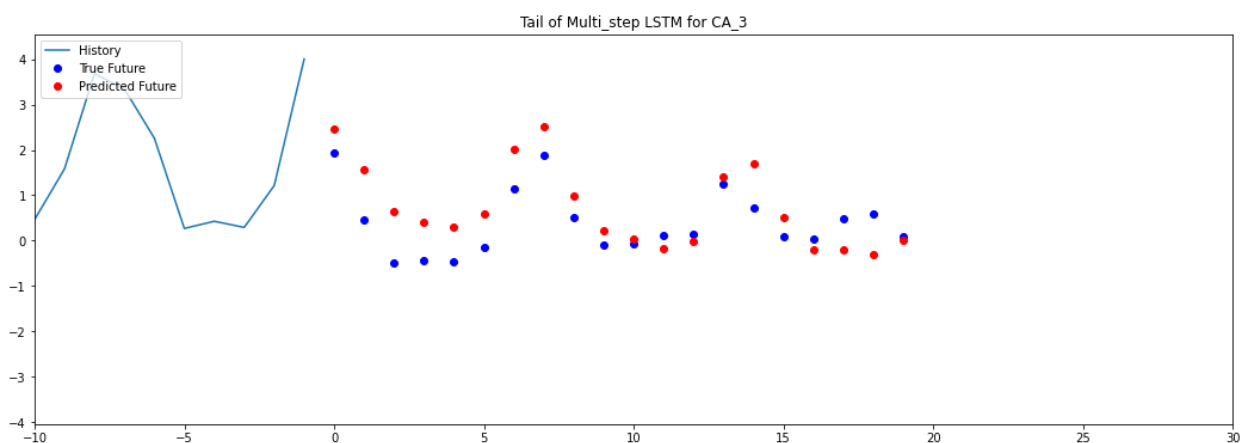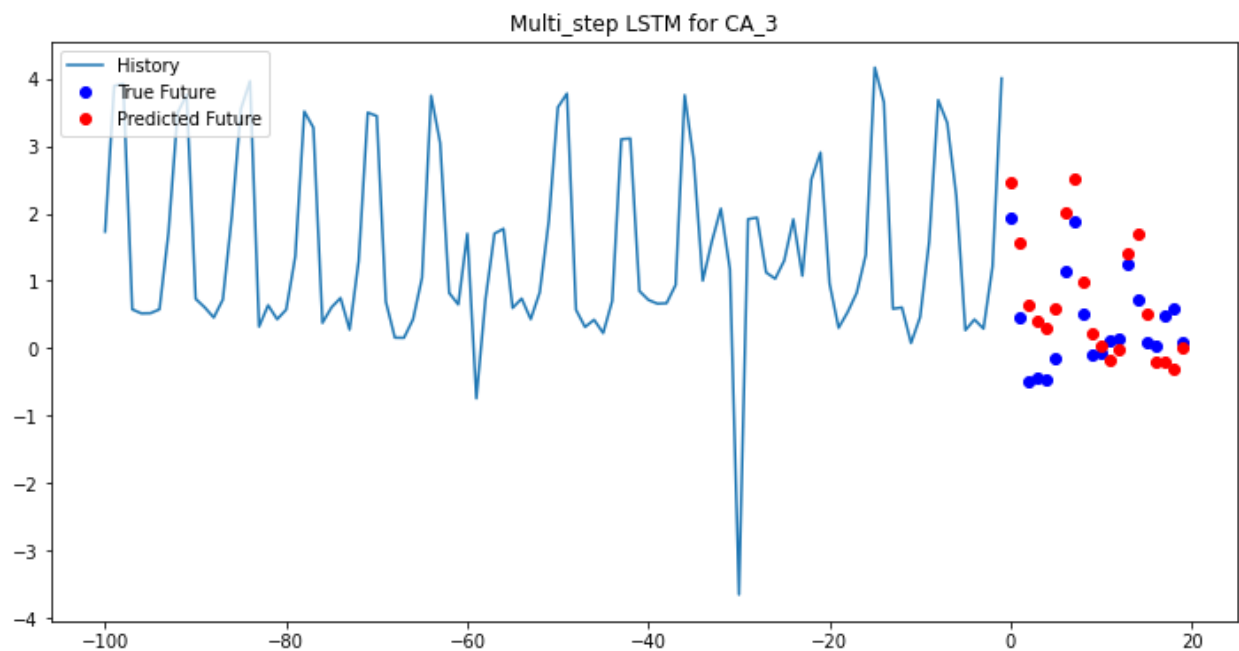
CA_3 - True Future: [8164. 6371. 5244. 5309. 5261. 5637. 7217. 8094. 6446. 5722. 5740. 5951.
 5986. 7347. 6696. 5930. 5882. 6421. 6547. 5928.]
CA_3 - Model Prediction: [8807.6   7707.3125 6603.589 6311.3486 6199.8994 6531.5215 8268.273
 8874.371 7027.5576 6098.6963 5863.247 5618.713 5816.7896 7529.1978
 7887.3926 6443.7554 5567.3677 5577.512 5445.0723 5842.332]
CA_3 - Model Percentage Error: [7.88338571 20.97492544 25.92656116 18.88017768 17.84640589
15.86875083
 14.56662654 9.64135278 9.0219922   6.58329761 2.1471615   5.58371886
  2.82676995 2.47989321 17.79260123 8.66366562 5.34907046 13.13639298
 16.83103306 1.44514117]%
CA_3 - Model Mean Percentage Error: 11.172446193347922%
====================================
====================================
Training for CA_1
Single window of past history : (100, 4)

```
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 116ms/step - loss: 0.7786 - val_loss: 0.7205
Epoch 2/100
50/50 [==============================] - 5s 105ms/step - loss: 0.7708 - val_loss: 0.7205
Epoch 3/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7561 - val_loss: 0.7203
Epoch 4/100
50/50 [==============================] - 5s 108ms/step - loss: 0.7357 - val_loss: 0.7196
Epoch 5/100
50/50 [==============================] - 6s 111ms/step - loss: 0.7206 - val_loss: 0.7185
Epoch 6/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7097 - val_loss: 0.7176
Epoch 7/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7036 - val_loss: 0.7175
Epoch 8/100
50/50 [==============================] - 5s 108ms/step - loss: 0.7002 - val_loss: 0.7179
Epoch 9/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6985 - val_loss: 0.7178
Epoch 10/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6961 - val_loss: 0.7179
Epoch 11/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6946 - val_loss: 0.7180
Epoch 12/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6926 - val_loss: 0.7183
Epoch 13/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6915 - val_loss: 0.7189
Epoch 14/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6899 - val_loss: 0.7194
Epoch 15/100
50/50 [==============================] - 5s 110ms/step - loss: 0.6886 - val_loss: 0.7202
Epoch 16/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6861 - val_loss: 0.7214
Epoch 17/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6853 - val_loss: 0.7213
Epoch 18/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6802 - val_loss: 0.7210
Epoch 19/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6774 - val_loss: 0.7182
Epoch 20/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6717 - val_loss: 0.7125
Epoch 21/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6625 - val_loss: 0.7037
Epoch 22/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6468 - val_loss: 0.6827
```

```
Epoch 23/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6121 - val_loss: 0.6304
Epoch 24/100
50/50 [==============================] - 5s 107ms/step - loss: 0.5414 - val_loss: 0.5125
Epoch 25/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4667 - val_loss: 0.4438
Epoch 26/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4378 - val_loss: 0.4325
Epoch 27/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4068 - val_loss: 0.4601
Epoch 28/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3969 - val_loss: 0.4128
Epoch 29/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3901 - val_loss: 0.4043
Epoch 30/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3841 - val_loss: 0.4106
Epoch 31/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3806 - val_loss: 0.4145
Epoch 32/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3767 - val_loss: 0.3840
Epoch 33/100
50/50 [==============================] - 5s 99ms/step - loss: 0.3734 - val_loss: 0.4239
Epoch 34/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3694 - val_loss: 0.3765
Epoch 35/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3693 - val_loss: 0.3710
Epoch 36/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3628 - val_loss: 0.3645
Epoch 37/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3637 - val_loss: 0.4031
Epoch 38/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3589 - val_loss: 0.3736
Epoch 39/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3561 - val_loss: 0.3990
Epoch 40/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3558 - val_loss: 0.3551
Epoch 41/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3517 - val_loss: 0.3696
Epoch 42/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3528 - val_loss: 0.3683
Epoch 43/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3460 - val_loss: 0.3558
Epoch 44/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3507 - val_loss: 0.3688
Epoch 45/100
```

```
50/50 [==============================] - 5s 107ms/step - loss: 0.3449 - val_loss: 0.3731
Epoch 46/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3410 - val_loss: 0.3510
Epoch 47/100
50/50 [==============================] - 6s 121ms/step - loss: 0.3397 - val_loss: 0.3603
Epoch 48/100
50/50 [==============================] - 6s 124ms/step - loss: 0.3409 - val_loss: 0.3474
Epoch 49/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3330 - val_loss: 0.3525
Epoch 50/100
50/50 [==============================] - 6s 124ms/step - loss: 0.3345 - val_loss: 0.3419
Epoch 51/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3326 - val_loss: 0.3487
Epoch 52/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3269 - val_loss: 0.3468
Epoch 53/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3495 - val_loss: 0.3390
Epoch 54/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3235 - val_loss: 0.3448
Epoch 55/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3228 - val_loss: 0.3416
Epoch 56/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3167 - val_loss: 0.3537
Epoch 57/100
50/50 [==============================] - 6s 116ms/step - loss: 0.3227 - val_loss: 0.4384
Epoch 58/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3182 - val_loss: 0.3348
Epoch 59/100
50/50 [==============================] - 6s 117ms/step - loss: 0.3137 - val_loss: 0.3191
Epoch 60/100
50/50 [==============================] - 6s 120ms/step - loss: 0.3094 - val_loss: 0.3304
Epoch 61/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3240 - val_loss: 0.3272
Epoch 62/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3058 - val_loss: 0.3628
Epoch 63/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3152 - val_loss: 0.3370
Epoch 64/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3049 - val_loss: 0.3284
Epoch 65/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3016 - val_loss: 0.3374
Epoch 66/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3241 - val_loss: 0.3355
Epoch 67/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3015 - val_loss: 0.3274
```

```
Epoch 68/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2995 - val_loss: 0.3284
Epoch 69/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3337 - val_loss: 0.3372
Epoch 70/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2995 - val_loss: 0.3343
Epoch 71/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2937 - val_loss: 0.3315
Epoch 72/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2914 - val_loss: 0.3360
Epoch 73/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2917 - val_loss: 0.3261
Epoch 74/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3888 - val_loss: 0.3360
Epoch 75/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2909 - val_loss: 0.3319
Epoch 76/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2876 - val_loss: 0.3297
Epoch 77/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2868 - val_loss: 0.3301
Epoch 78/100
50/50 [==============================] - 6s 118ms/step - loss: 0.2989 - val_loss: 0.3350
Epoch 79/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2840 - val_loss: 0.3250
Epoch 80/100
50/50 [==============================] - 6s 113ms/step - loss: 0.2825 - val_loss: 0.3373
Epoch 81/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2811 - val_loss: 0.3256
Epoch 82/100
50/50 [==============================] - 6s 114ms/step - loss: 0.2807 - val_loss: 0.3183
Epoch 83/100
50/50 [==============================] - 7s 147ms/step - loss: 0.3077 - val_loss: 0.3197
Epoch 84/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2803 - val_loss: 0.3206
Epoch 85/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2782 - val_loss: 0.3260
Epoch 86/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2860 - val_loss: 0.4380
Epoch 87/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2889 - val_loss: 0.3285
Epoch 88/100
50/50 [==============================] - 6s 111ms/step - loss: 0.2761 - val_loss: 0.3344
Epoch 89/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2763 - val_loss: 0.3316
Epoch 90/100
```

```
50/50 [==============================] - 5s 109ms/step - loss: 0.2869 - val_loss: 0.3440
Epoch 91/100
50/50 [==============================] - 5s 110ms/step - loss: 0.2743 - val_loss: 0.3368
Epoch 92/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2718 - val_loss: 0.3090
Epoch 93/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2741 - val_loss: 0.3137
Epoch 94/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2816 - val_loss: 0.3718
Epoch 95/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2782 - val_loss: 0.3189
Epoch 96/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2697 - val_loss: 0.3200
Epoch 97/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2707 - val_loss: 0.3199
Epoch 98/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2686 - val_loss: 0.3123
Epoch 99/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2690 - val_loss: 0.3355
Epoch 100/100
50/50 [==============================] - 6s 110ms/step - loss: 0.2682 - val_loss: 0.3284
```


Multi-Step Training and validation loss for CA_1

Multi_step LSTM for CA_1

Tail of Multi_step LSTM for CA_1
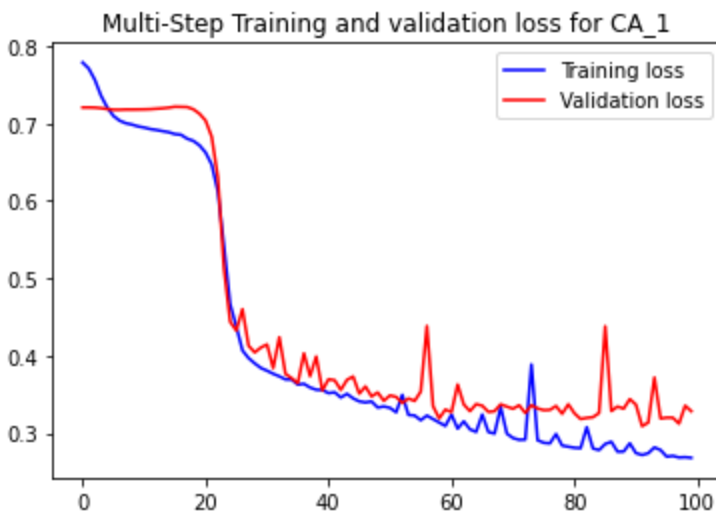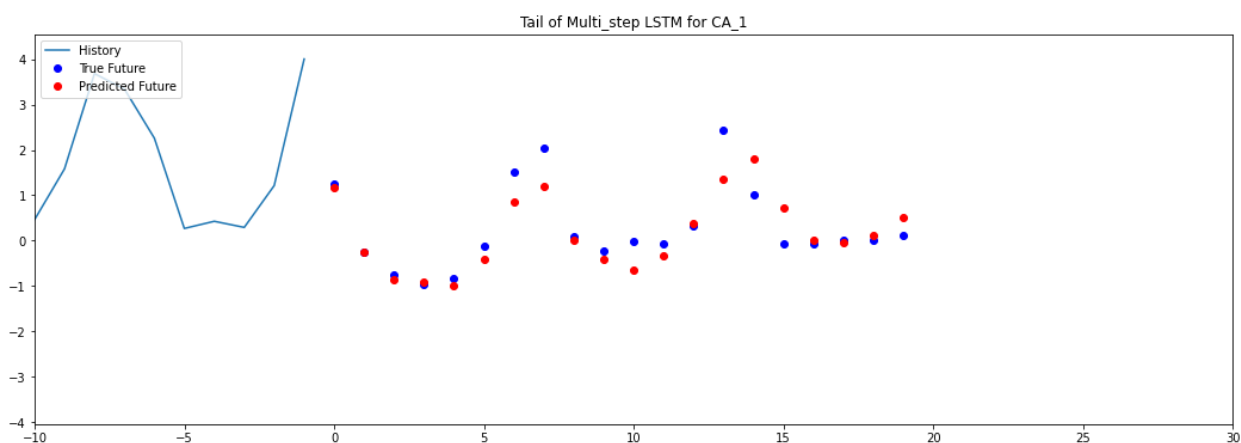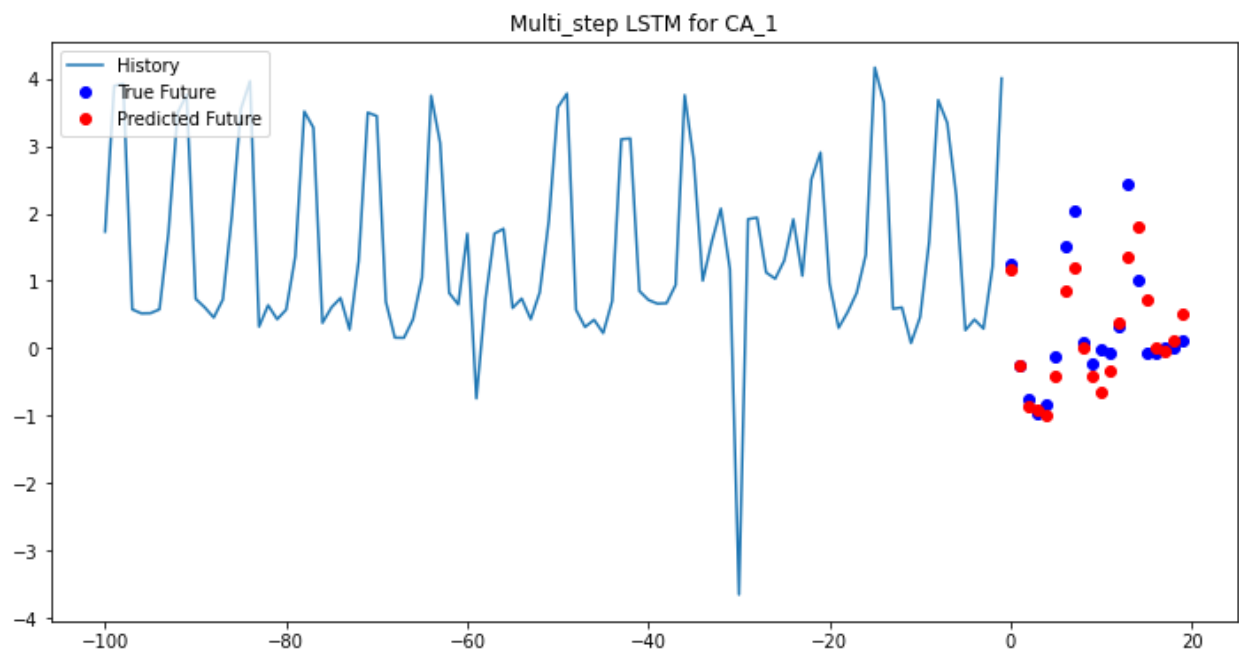
CA_1 - True Future: [5247. 3741. 3246. 3031. 3173. 3871. 5498. 6032. 4075. 3765. 3983. 3928. 4327. 6412. 4986. 3933. 3936. 3995. 4007. 4111.]

CA_1 - Model Prediction: [5167.1685 3746.7156 3150.9092 3083.6602 3004.9973 3592.1797 4833.465
 5181.9395 4001.2126 3591.48   3339.9983 3673.8926 4375.151 5344.5254
 5794.0977 4707.6646 3997.7124 3961.501 4112.0977 4503.5337]

CA_1 - Model Percentage Error: [1.52147023 0.15278204 2.9294769   1.73738556 5.29475845 7.20279805
 12.08685261 14.0925157   1.8107326   4.60876546 16.14365325 6.46912988
  1.11280053 16.64807563 16.20733366 19.69653066 1.5678964   0.83852374
  2.62285142 9.54837488]%

CA_1 - Model Mean Percentage Error: 7.114635382323106%

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Training for TX_1

Single window of past history : (100, 3)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 116ms/step - loss: 0.7540 - val_loss: 0.7695
Epoch 2/100
50/50 [==============================] - 5s 105ms/step - loss: 0.7339 - val_loss: 0.7663
Epoch 3/100
50/50 [==============================] - 5s 105ms/step - loss: 0.7231 - val_loss: 0.7618
Epoch 4/100
50/50 [==============================] - 6s 111ms/step - loss: 0.7140 - val_loss: 0.7562
Epoch 5/100
50/50 [==============================] - 6s 129ms/step - loss: 0.7109 - val_loss: 0.7508
Epoch 6/100
50/50 [==============================] - 5s 106ms/step - loss: 0.7073 - val_loss: 0.7461
Epoch 7/100
50/50 [==============================] - 5s 103ms/step - loss: 0.7064 - val_loss: 0.7422
Epoch 8/100
50/50 [==============================] - 5s 106ms/step - loss: 0.7055 - val_loss: 0.7390
Epoch 9/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7044 - val_loss: 0.7363
Epoch 10/100
50/50 [==============================] - 5s 109ms/step - loss: 0.7040 - val_loss: 0.7337
Epoch 11/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7030 - val_loss: 0.7316
Epoch 12/100
50/50 [==============================] - 5s 108ms/step - loss: 0.7032 - val_loss: 0.7297
Epoch 13/100
50/50 [==============================] - 5s 105ms/step - loss: 0.7014 - val_loss: 0.7280
Epoch 14/100
50/50 [==============================] - 6s 110ms/step - loss: 0.7011 - val_loss: 0.7264
Epoch 15/100
50/50 [==============================] - 6s 112ms/step - loss: 0.7001 - val_loss: 0.7254
Epoch 16/100
50/50 [==============================] - 6s 114ms/step - loss: 0.6999 - val_loss: 0.7254
Epoch 17/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6984 - val_loss: 0.7259
Epoch 18/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6978 - val_loss: 0.7261
Epoch 19/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6963 - val_loss: 0.7261
Epoch 20/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6956 - val_loss: 0.7278
Epoch 21/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6943 - val_loss: 0.7305
Epoch 22/100

```
50/50 [==============================] - 5s 107ms/step - loss: 0.6928 - val_loss: 0.7343
Epoch 23/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6915 - val_loss: 0.7400
Epoch 24/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6906 - val_loss: 0.7329
Epoch 25/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6883 - val_loss: 0.7444
Epoch 26/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6873 - val_loss: 0.7456
Epoch 27/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6856 - val_loss: 0.7445
Epoch 28/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6836 - val_loss: 0.7417
Epoch 29/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6828 - val_loss: 0.7459
Epoch 30/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6798 - val_loss: 0.7488
Epoch 31/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6785 - val_loss: 0.7437
Epoch 32/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6755 - val_loss: 0.7569
Epoch 33/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6723 - val_loss: 0.7434
Epoch 34/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6690 - val_loss: 0.7536
Epoch 35/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6656 - val_loss: 0.7584
Epoch 36/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6614 - val_loss: 0.7855
Epoch 37/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6572 - val_loss: 0.7684
Epoch 38/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6500 - val_loss: 0.7377
Epoch 39/100
50/50 [==============================] - 6s 117ms/step - loss: 0.6447 - val_loss: 0.7846
Epoch 40/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6349 - val_loss: 0.7091
Epoch 41/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6249 - val_loss: 0.7560
Epoch 42/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6138 - val_loss: 0.6573
Epoch 43/100
50/50 [==============================] - 5s 107ms/step - loss: 0.5931 - val_loss: 0.6350
Epoch 44/100
50/50 [==============================] - 6s 111ms/step - loss: 0.5659 - val_loss: 0.5814
```

```
Epoch 45/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5411 - val_loss: 0.5465
Epoch 46/100
50/50 [==============================] - 5s 103ms/step - loss: 0.5056 - val_loss: 0.5190
Epoch 47/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4863 - val_loss: 0.5042
Epoch 48/100
50/50 [==============================] - 5s 110ms/step - loss: 0.4768 - val_loss: 0.4904
Epoch 49/100
50/50 [==============================] - 6s 112ms/step - loss: 0.4686 - val_loss: 0.4836
Epoch 50/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4643 - val_loss: 0.4771
Epoch 51/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4586 - val_loss: 0.4761
Epoch 52/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4538 - val_loss: 0.4565
Epoch 53/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4445 - val_loss: 0.5262
Epoch 54/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4461 - val_loss: 0.4281
Epoch 55/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4392 - val_loss: 0.4474
Epoch 56/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4301 - val_loss: 0.4343
Epoch 57/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4253 - val_loss: 0.4346
Epoch 58/100
50/50 [==============================] - 5s 100ms/step - loss: 0.4155 - val_loss: 0.4996
Epoch 59/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4140 - val_loss: 0.4229
Epoch 60/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4025 - val_loss: 0.4213
Epoch 61/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3977 - val_loss: 0.4214
Epoch 62/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3935 - val_loss: 0.4566
Epoch 63/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3957 - val_loss: 0.4495
Epoch 64/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3811 - val_loss: 0.5049
Epoch 65/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3833 - val_loss: 0.4771
Epoch 66/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3798 - val_loss: 0.4379
Epoch 67/100
```

```
50/50 [==============================] - 5s 106ms/step - loss: 0.3738 - val_loss: 0.4450
Epoch 68/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3733 - val_loss: 0.4568
Epoch 69/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3826 - val_loss: 0.4717
Epoch 70/100
50/50 [==============================] - 6s 116ms/step - loss: 0.3672 - val_loss: 0.4876
Epoch 71/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3655 - val_loss: 0.4948
Epoch 72/100
50/50 [==============================] - 6s 111ms/step - loss: 0.4087 - val_loss: 0.4714
Epoch 73/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3646 - val_loss: 0.4841
Epoch 74/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3624 - val_loss: 0.4807
Epoch 75/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3634 - val_loss: 0.4767
Epoch 76/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3572 - val_loss: 0.4803
Epoch 77/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3717 - val_loss: 0.4727
Epoch 78/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3552 - val_loss: 0.4564
Epoch 79/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3934 - val_loss: 0.4897
Epoch 80/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3609 - val_loss: 0.4987
Epoch 81/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3540 - val_loss: 0.4829
Epoch 82/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3515 - val_loss: 0.4515
Epoch 83/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3505 - val_loss: 0.4859
Epoch 84/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3632 - val_loss: 0.4625
Epoch 85/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3464 - val_loss: 0.4789
Epoch 86/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3640 - val_loss: 0.4677
Epoch 87/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3456 - val_loss: 0.4698
Epoch 88/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3429 - val_loss: 0.4472
Epoch 89/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3414 - val_loss: 0.4916
```

```
Epoch 90/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3678 - val_loss: 0.4858
Epoch 91/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3403 - val_loss: 0.5134
Epoch 92/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4689 - val_loss: 0.6923
Epoch 93/100
50/50 [==============================] - 8s 157ms/step - loss: 0.6358 - val_loss: 0.6755
Epoch 94/100
50/50 [==============================] - 5s 107ms/step - loss: 0.5731 - val_loss: 0.5982
Epoch 95/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4097 - val_loss: 0.5128
Epoch 96/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3540 - val_loss: 0.4776
Epoch 97/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3450 - val_loss: 0.4805
Epoch 98/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3412 - val_loss: 0.4665
Epoch 99/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3380 - val_loss: 0.4624
Epoch 100/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3364 - val_loss: 0.4441
```


Multi-Step Training and validation loss for TX_1

Multi_step LSTM for TX_1

Tail of Multi_step LSTM for TX_1
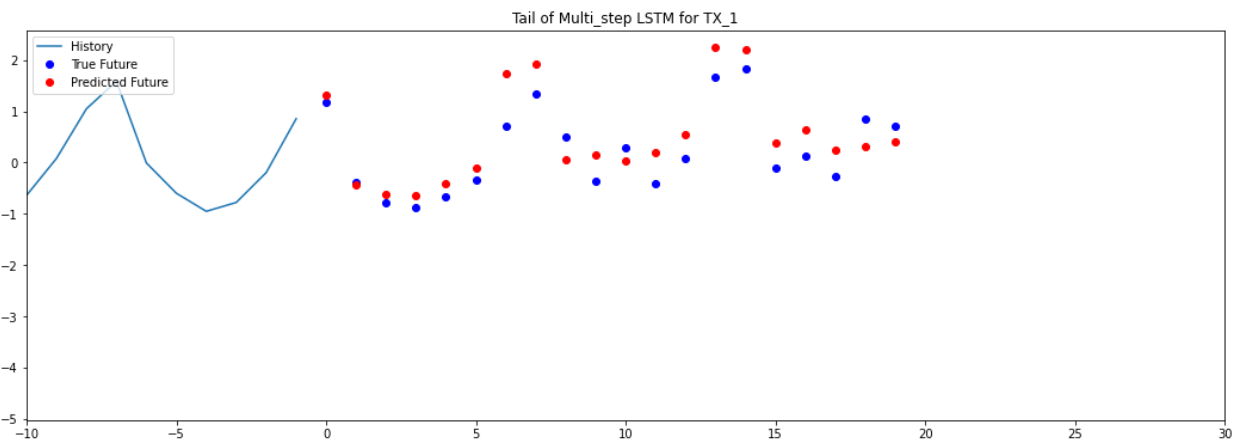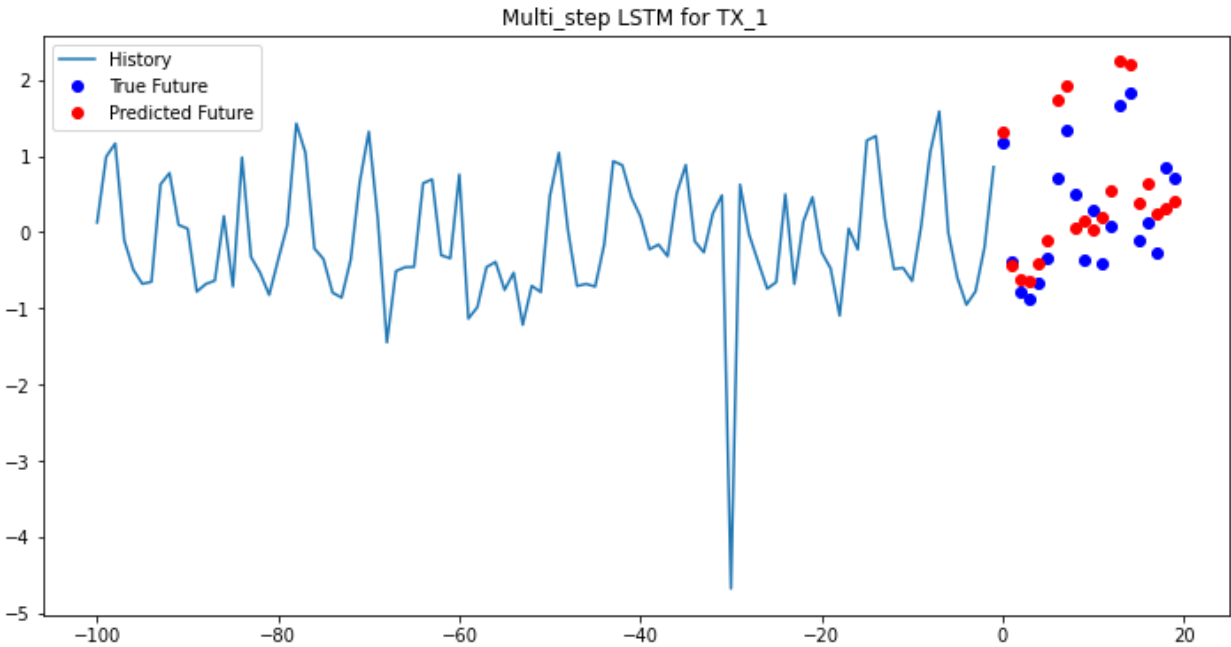
TX_1 - True Future: [3639. 2666. 2426. 2357. 2497. 2693. 3347. 3727. 3213. 2681. 3081. 2645.
 2949. 3939. 4034. 2845. 2978. 2745. 3431. 3343.]
TX_1 - Model Prediction: [3725.2246 2629.907 2525.9678 2514.4517 2649.126 2841.279
3971.6626
 4090.6519 2943.3293 3000.0889 2928.229 3022.995 3239.412 4289.3584
 4264.485 3145.4546 3296.914 3051.7637 3094.212 3153.2625]
TX_1 - Model Percentage Error: [2.3694589   1.35382662 4.12068316 6.68017226 6.09234988
5.50609182
 18.66335816 9.75722714 8.39311093 11.90186002 4.95848738 14.29093071
  9.84781653 8.89460265 5.71355635 10.56079402 10.70900143 11.17536145
  9.81603282 5.67566703]%
TX_1 - Model Mean Percentage Error: 8.32401946271181%
===================================
===================================
Training for TX_3

```
Single window of past history : (100, 3)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 120ms/step - loss: 0.7517 - val_loss: 1.0851
Epoch 2/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7312 - val_loss: 1.0467
Epoch 3/100
50/50 [==============================] - 5s 109ms/step - loss: 0.7100 - val_loss: 0.9873
Epoch 4/100
50/50 [==============================] - 5s 110ms/step - loss: 0.6875 - val_loss: 0.8868
Epoch 5/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6620 - val_loss: 0.7812
Epoch 6/100
50/50 [==============================] - 6s 114ms/step - loss: 0.6458 - val_loss: 0.7208
Epoch 7/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6368 - val_loss: 0.7030
Epoch 8/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6335 - val_loss: 0.7002
Epoch 9/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6310 - val_loss: 0.7175
Epoch 10/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6377 - val_loss: 0.6913
Epoch 11/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6309 - val_loss: 0.7026
Epoch 12/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6295 - val_loss: 0.7166
Epoch 13/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6288 - val_loss: 0.7403
Epoch 14/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6279 - val_loss: 0.7402
Epoch 15/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6274 - val_loss: 0.7473
Epoch 16/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6274 - val_loss: 0.7520
Epoch 17/100
50/50 [==============================] - 6s 118ms/step - loss: 0.6269 - val_loss: 0.7495
Epoch 18/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6253 - val_loss: 0.7532
Epoch 19/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6261 - val_loss: 0.7456
Epoch 20/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6252 - val_loss: 0.7486
Epoch 21/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6251 - val_loss: 0.7207
Epoch 22/100
```

```
50/50 [==============================] - 5s 105ms/step - loss: 0.6244 - val_loss: 0.7381
Epoch 23/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6237 - val_loss: 0.7476
Epoch 24/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6228 - val_loss: 0.7576
Epoch 25/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6240 - val_loss: 0.7251
Epoch 26/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6222 - val_loss: 0.7416
Epoch 27/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6216 - val_loss: 0.7363
Epoch 28/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6220 - val_loss: 0.6955
Epoch 29/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6215 - val_loss: 0.7126
Epoch 30/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6194 - val_loss: 0.7356
Epoch 31/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6187 - val_loss: 0.7633
Epoch 32/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6184 - val_loss: 0.7530
Epoch 33/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6170 - val_loss: 0.7395
Epoch 34/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6165 - val_loss: 0.7444
Epoch 35/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6154 - val_loss: 0.7499
Epoch 36/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6162 - val_loss: 0.7303
Epoch 37/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6128 - val_loss: 0.7481
Epoch 38/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6105 - val_loss: 0.7335
Epoch 39/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6265 - val_loss: 0.7308
Epoch 40/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6171 - val_loss: 0.6760
Epoch 41/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6099 - val_loss: 0.6785
Epoch 42/100
50/50 [==============================] - 5s 108ms/step - loss: 0.6060 - val_loss: 0.6709
Epoch 43/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6004 - val_loss: 0.6781
Epoch 44/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5924 - val_loss: 0.6801
```

```
Epoch 45/100
50/50 [==============================] - 5s 107ms/step - loss: 0.5804 - val_loss: 0.6348
Epoch 46/100
50/50 [==============================] - 5s 109ms/step - loss: 0.5461 - val_loss: 0.5541
Epoch 47/100
50/50 [==============================] - 5s 110ms/step - loss: 0.5024 - val_loss: 0.6104
Epoch 48/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4675 - val_loss: 0.5515
Epoch 49/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4481 - val_loss: 0.5249
Epoch 50/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4365 - val_loss: 0.5100
Epoch 51/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4292 - val_loss: 0.5180
Epoch 52/100
50/50 [==============================] - 5s 110ms/step - loss: 0.4266 - val_loss: 0.5527
Epoch 53/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4248 - val_loss: 0.5522
Epoch 54/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4211 - val_loss: 0.5505
Epoch 55/100
50/50 [==============================] - 6s 112ms/step - loss: 0.4176 - val_loss: 0.5291
Epoch 56/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4172 - val_loss: 0.5438
Epoch 57/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4118 - val_loss: 0.5568
Epoch 58/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4110 - val_loss: 0.5193
Epoch 59/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4094 - val_loss: 0.5243
Epoch 60/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4056 - val_loss: 0.5383
Epoch 61/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4053 - val_loss: 0.5083
Epoch 62/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4019 - val_loss: 0.5127
Epoch 63/100
50/50 [==============================] - 6s 114ms/step - loss: 0.4008 - val_loss: 0.5213
Epoch 64/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3952 - val_loss: 0.4859
Epoch 65/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3943 - val_loss: 0.4946
Epoch 66/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3905 - val_loss: 0.5060
Epoch 67/100
```

```
50/50 [==============================] - 5s 106ms/step - loss: 0.3888 - val_loss: 0.4992
Epoch 68/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3864 - val_loss: 0.5051
Epoch 69/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3865 - val_loss: 0.5018
Epoch 70/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3817 - val_loss: 0.4919
Epoch 71/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3804 - val_loss: 0.4725
Epoch 72/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3799 - val_loss: 0.4885
Epoch 73/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3762 - val_loss: 0.4743
Epoch 74/100
50/50 [==============================] - 6s 117ms/step - loss: 0.3747 - val_loss: 0.4754
Epoch 75/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3746 - val_loss: 0.4749
Epoch 76/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3741 - val_loss: 0.4626
Epoch 77/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3722 - val_loss: 0.4684
Epoch 78/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3709 - val_loss: 0.4596
Epoch 79/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3693 - val_loss: 0.4715
Epoch 80/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3698 - val_loss: 0.4515
Epoch 81/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3682 - val_loss: 0.4607
Epoch 82/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3660 - val_loss: 0.4441
Epoch 83/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3672 - val_loss: 0.4385
Epoch 84/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3643 - val_loss: 0.4536
Epoch 85/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3627 - val_loss: 0.4459
Epoch 86/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3621 - val_loss: 0.4506
Epoch 87/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3611 - val_loss: 0.4484
Epoch 88/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3609 - val_loss: 0.4317
Epoch 89/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3596 - val_loss: 0.4326
```

```
Epoch 90/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3601 - val_loss: 0.4354
Epoch 91/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3576 - val_loss: 0.4217
Epoch 92/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3555 - val_loss: 0.4382
Epoch 93/100
50/50 [==============================] - 6s 114ms/step - loss: 0.3538 - val_loss: 0.4362
Epoch 94/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3532 - val_loss: 0.4257
Epoch 95/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3515 - val_loss: 0.4372
Epoch 96/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3494 - val_loss: 0.4286
Epoch 97/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3487 - val_loss: 0.4291
Epoch 98/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3493 - val_loss: 0.4304
Epoch 99/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3452 - val_loss: 0.4381
Epoch 100/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3436 - val_loss: 0.4349
```


Multi-Step Training and validation loss for TX_3

Multi_step LSTM for TX_3

Tail of Multi_step LSTM for TX_3
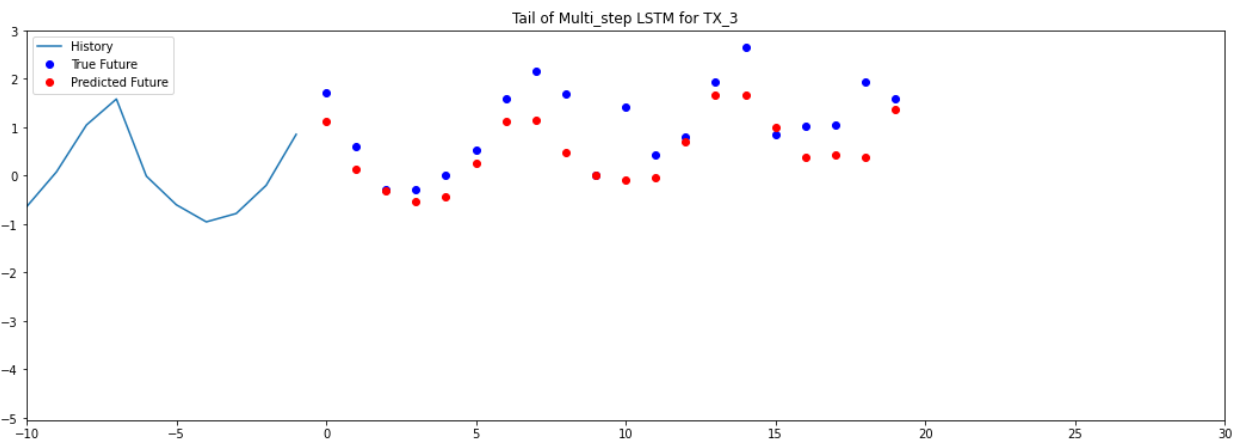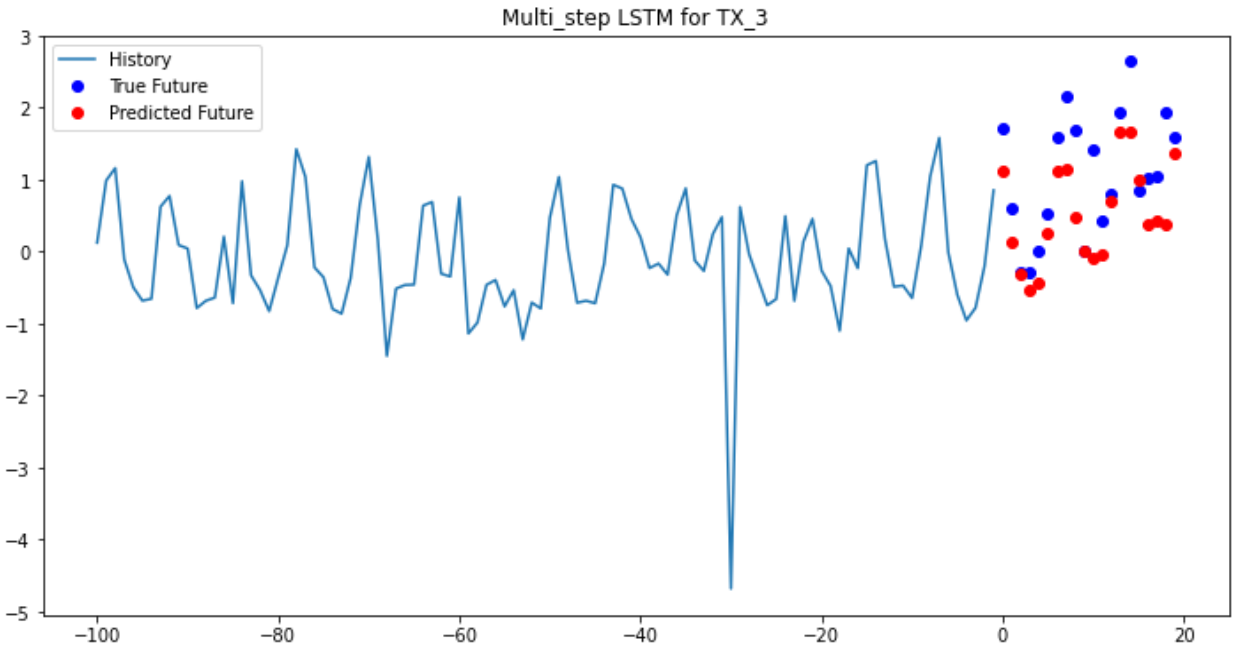
TX_3 - True Future: [4286. 3538. 2934. 2939. 3135. 3486. 4202. 4575. 4262. 3141. 4091. 3421.
 3664. 4432. 4905. 3707. 3825. 3831. 4438. 4198.]

TX_3 - Model Prediction: [3882.5054 3226.2222 2925.9175 2765.1064 2832.9153 3309.5083
3880.9146
 3907.1921 3454.0515 3133.5403 3073.403 3098.9924 3606.803 4254.6665
 4254.9824 3793.8123 3382.8484 3419.227 3381.6235 4047.511]

TX_3 - Model Percentage Error: [9.41424706 8.81226207 0.27547783 5.91675926 9.63587613
5.06287146
  7.64125296 14.59689314 18.9570269   0.23749496 24.87403871 9.41267373
  1.56105408 4.00120704 13.25214227 2.34184666 11.55951925 10.74844556
 23.80298479 3.58477879]%

TX_3 - Model Mean Percentage Error: 9.284442632937516%

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Training for TX_2

Single window of past history : (100, 3)
(72, 20)
Epoch 1/100
50/50 [==============================] - 7s 149ms/step - loss: 0.7714 - val_loss: 0.6848
Epoch 2/100
50/50 [==============================] - 6s 115ms/step - loss: 0.7686 - val_loss: 0.6879
Epoch 3/100
50/50 [==============================] - 5s 109ms/step - loss: 0.7648 - val_loss: 0.6925
Epoch 4/100
50/50 [==============================] - 6s 110ms/step - loss: 0.7649 - val_loss: 0.6967
Epoch 5/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7632 - val_loss: 0.7002
Epoch 6/100
50/50 [==============================] - 5s 105ms/step - loss: 0.7612 - val_loss: 0.7030
Epoch 7/100
50/50 [==============================] - 5s 103ms/step - loss: 0.7605 - val_loss: 0.7050
Epoch 8/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7589 - val_loss: 0.7060
Epoch 9/100
50/50 [==============================] - 5s 102ms/step - loss: 0.7558 - val_loss: 0.7062
Epoch 10/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7526 - val_loss: 0.7051
Epoch 11/100
50/50 [==============================] - 5s 101ms/step - loss: 0.7470 - val_loss: 0.7023
Epoch 12/100
50/50 [==============================] - 5s 103ms/step - loss: 0.7369 - val_loss: 0.7008
Epoch 13/100
50/50 [==============================] - 5s 102ms/step - loss: 0.7225 - val_loss: 0.7021
Epoch 14/100
50/50 [==============================] - 5s 101ms/step - loss: 0.7098 - val_loss: 0.7057
Epoch 15/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7021 - val_loss: 0.7071
Epoch 16/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6970 - val_loss: 0.7104
Epoch 17/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6934 - val_loss: 0.7111
Epoch 18/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6919 - val_loss: 0.7158
Epoch 19/100
50/50 [==============================] - 6s 110ms/step - loss: 0.6905 - val_loss: 0.7178
Epoch 20/100
50/50 [==============================] - 6s 110ms/step - loss: 0.6882 - val_loss: 0.7199
Epoch 21/100
50/50 [==============================] - 5s 110ms/step - loss: 0.6869 - val_loss: 0.7267
Epoch 22/100

```
50/50 [==============================] - 5s 103ms/step - loss: 0.6856 - val_loss: 0.7318
Epoch 23/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6837 - val_loss: 0.7354
Epoch 24/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6839 - val_loss: 0.7432
Epoch 25/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6794 - val_loss: 0.7433
Epoch 26/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6785 - val_loss: 0.7491
Epoch 27/100
50/50 [==============================] - 5s 103ms/step - loss: 0.6752 - val_loss: 0.7506
Epoch 28/100
50/50 [==============================] - 6s 111ms/step - loss: 0.6723 - val_loss: 0.7434
Epoch 29/100
50/50 [==============================] - 6s 119ms/step - loss: 0.6644 - val_loss: 0.7425
Epoch 30/100
50/50 [==============================] - 6s 112ms/step - loss: 0.6447 - val_loss: 0.6339
Epoch 31/100
50/50 [==============================] - 5s 107ms/step - loss: 0.5799 - val_loss: 0.6289
Epoch 32/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5255 - val_loss: 0.5463
Epoch 33/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4843 - val_loss: 0.5321
Epoch 34/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4656 - val_loss: 0.5155
Epoch 35/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4564 - val_loss: 0.4925
Epoch 36/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4511 - val_loss: 0.4739
Epoch 37/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4499 - val_loss: 0.4974
Epoch 38/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4430 - val_loss: 0.4704
Epoch 39/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4435 - val_loss: 0.4599
Epoch 40/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4399 - val_loss: 0.4866
Epoch 41/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4339 - val_loss: 0.4577
Epoch 42/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4411 - val_loss: 0.4451
Epoch 43/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4241 - val_loss: 0.4413
Epoch 44/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4257 - val_loss: 0.4582
```

```
Epoch 45/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4197 - val_loss: 0.4461
Epoch 46/100
50/50 [==============================] - 5s 102ms/step - loss: 0.4152 - val_loss: 0.4728
Epoch 47/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4153 - val_loss: 0.4802
Epoch 48/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4055 - val_loss: 0.5343
Epoch 49/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4063 - val_loss: 0.4455
Epoch 50/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3979 - val_loss: 0.4482
Epoch 51/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3986 - val_loss: 0.4286
Epoch 52/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3953 - val_loss: 0.4731
Epoch 53/100
50/50 [==============================] - 7s 144ms/step - loss: 0.3897 - val_loss: 0.4952
Epoch 54/100
50/50 [==============================] - 7s 150ms/step - loss: 0.3835 - val_loss: 0.4292
Epoch 55/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3835 - val_loss: 0.4797
Epoch 56/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3939 - val_loss: 0.4356
Epoch 57/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3751 - val_loss: 0.4706
Epoch 58/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3777 - val_loss: 0.4882
Epoch 59/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3770 - val_loss: 0.4773
Epoch 60/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3745 - val_loss: 0.4527
Epoch 61/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3650 - val_loss: 0.4740
Epoch 62/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4064 - val_loss: 0.4674
Epoch 63/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3630 - val_loss: 0.4397
Epoch 64/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3588 - val_loss: 0.4954
Epoch 65/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3749 - val_loss: 0.4748
Epoch 66/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3568 - val_loss: 0.4936
Epoch 67/100
```

```
50/50 [==============================] - 5s 103ms/step - loss: 0.3558 - val_loss: 0.5029
Epoch 68/100
50/50 [==============================] - 5s 105ms/step - loss: 0.5367 - val_loss: 0.6551
Epoch 69/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4173 - val_loss: 0.4629
Epoch 70/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3574 - val_loss: 0.4659
Epoch 71/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3526 - val_loss: 0.4933
Epoch 72/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3499 - val_loss: 0.5076
Epoch 73/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3475 - val_loss: 0.4347
Epoch 74/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3480 - val_loss: 0.4694
Epoch 75/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3459 - val_loss: 0.4519
Epoch 76/100
50/50 [==============================] - 6s 116ms/step - loss: 0.3432 - val_loss: 0.5067
Epoch 77/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3584 - val_loss: 0.4654
Epoch 78/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3448 - val_loss: 0.7170
Epoch 79/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3600 - val_loss: 0.4596
Epoch 80/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3389 - val_loss: 0.4902
Epoch 81/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3403 - val_loss: 0.4635
Epoch 82/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3346 - val_loss: 0.4628
Epoch 83/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3371 - val_loss: 0.4748
Epoch 84/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3368 - val_loss: 0.4513
Epoch 85/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3351 - val_loss: 0.4577
Epoch 86/100
50/50 [==============================] - 6s 116ms/step - loss: 0.3345 - val_loss: 0.4577
Epoch 87/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3348 - val_loss: 0.4581
Epoch 88/100
50/50 [==============================] - 5s 105ms/step - loss: 0.5242 - val_loss: 0.6314
Epoch 89/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3673 - val_loss: 0.4628
```

```
Epoch 90/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3349 - val_loss: 0.4801
Epoch 91/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3348 - val_loss: 0.4536
Epoch 92/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3312 - val_loss: 0.4725
Epoch 93/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3309 - val_loss: 0.4672
Epoch 94/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3294 - val_loss: 0.4611
Epoch 95/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3296 - val_loss: 0.4530
Epoch 96/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3285 - val_loss: 0.4569
Epoch 97/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3264 - val_loss: 0.4599
Epoch 98/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3983 - val_loss: 0.7251
Epoch 99/100
50/50 [==============================] - 5s 105ms/step - loss: 0.6536 - val_loss: 0.7065
Epoch 100/100
50/50 [==============================] - 5s 102ms/step - loss: 0.5399 - val_loss: 0.4757
```


Multi-Step Training and validation loss for TX_2

Multi_step LSTM for TX_2

Tail of Multi_step LSTM for TX_2
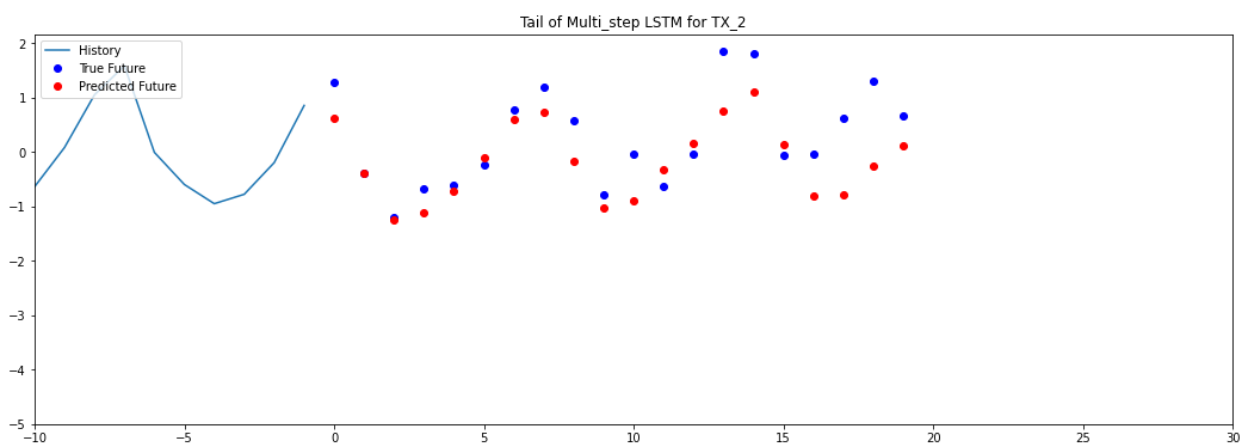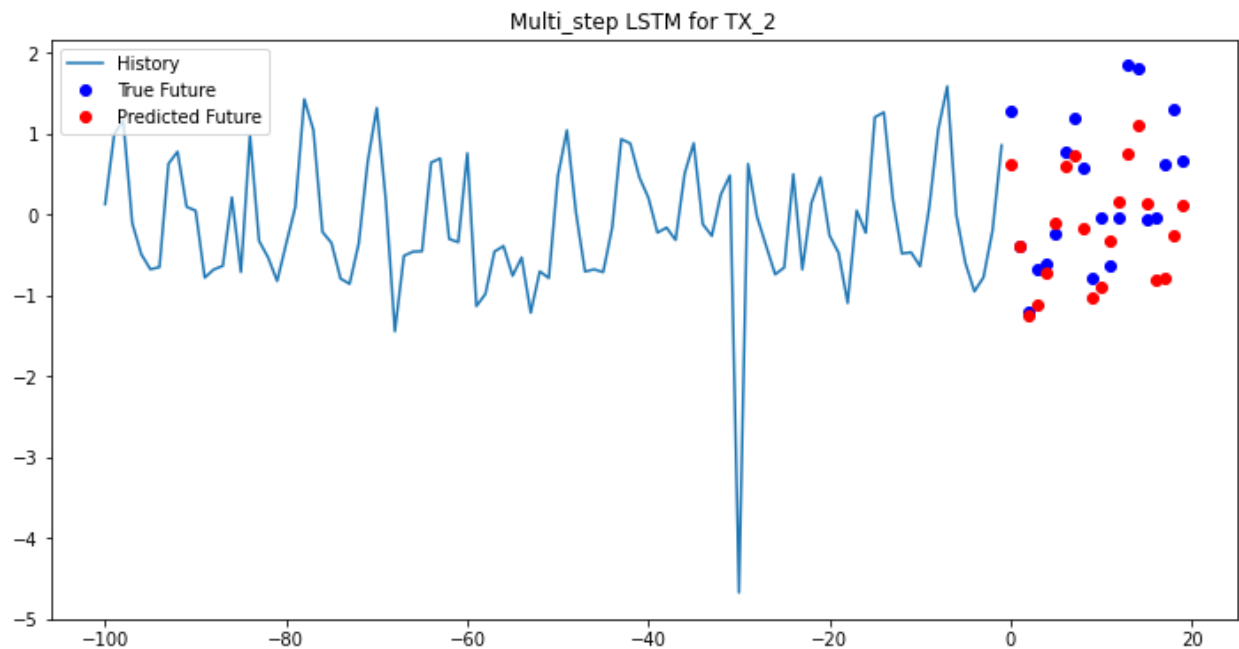
TX_2 - True Future: [4794. 3441. 2798. 3216. 3264. 3562. 4384. 4712. 4225. 3121. 3722. 3245.
 3737. 5240. 5210. 3714. 3737. 4259. 4799. 4295.]
TX_2 - Model Prediction: [4257.699 3446.2659 2762.6277 2865.6316 3184.5542 3676.3894
4235.1885
 4353.435 3617.5527 2933.051 3040.7205 3498.0427 3892.2183 4359.5825
 4652.148 3873.1577 3104.9824 3130.4177 3551.8599 3852.6726]
TX_2 - Model Percentage Error: [11.18691659 0.1530331   1.26419994 10.89454006 2.43400125
3.21138137
 3.39442344 7.60961251 14.37745007 6.02207544 18.30412523 7.7979268
 4.15355263 16.80186031 10.70733303 4.28534504 16.91243185 26.49876204
 25.98750024 10.29865873]%
TX_2 - Model Mean Percentage Error: 10.114756483995151%
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Training for WI_1

```
Single window of past history : (100, 3)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 117ms/step - loss: 0.7800 - val_loss: 1.3012
Epoch 2/100
50/50 [==============================] - 5s 106ms/step - loss: 0.7004 - val_loss: 1.2430
Epoch 3/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6063 - val_loss: 1.1254
Epoch 4/100
50/50 [==============================] - 5s 108ms/step - loss: 0.5386 - val_loss: 0.9524
Epoch 5/100
50/50 [==============================] - 5s 105ms/step - loss: 0.5078 - val_loss: 0.8643
Epoch 6/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5009 - val_loss: 0.8413
Epoch 7/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4975 - val_loss: 0.8471
Epoch 8/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4955 - val_loss: 0.8461
Epoch 9/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4958 - val_loss: 0.8407
Epoch 10/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4942 - val_loss: 0.8398
Epoch 11/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4922 - val_loss: 0.8396
Epoch 12/100
50/50 [==============================] - 8s 170ms/step - loss: 0.4929 - val_loss: 0.8388
Epoch 13/100
50/50 [==============================] - 6s 111ms/step - loss: 0.4912 - val_loss: 0.8443
Epoch 14/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4907 - val_loss: 0.8414
Epoch 15/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4899 - val_loss: 0.8379
Epoch 16/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4886 - val_loss: 0.8439
Epoch 17/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4875 - val_loss: 0.8478
Epoch 18/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4869 - val_loss: 0.8493
Epoch 19/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4852 - val_loss: 0.8450
Epoch 20/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4830 - val_loss: 0.8363
Epoch 21/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4794 - val_loss: 0.8434
Epoch 22/100
```

```
50/50 [==============================] - 5s 105ms/step - loss: 0.4779 - val_loss: 0.8125
Epoch 23/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4677 - val_loss: 0.8403
Epoch 24/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4528 - val_loss: 0.7565
Epoch 25/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4211 - val_loss: 0.6733
Epoch 26/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3925 - val_loss: 0.6075
Epoch 27/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3714 - val_loss: 0.5698
Epoch 28/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3604 - val_loss: 0.5468
Epoch 29/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3537 - val_loss: 0.5410
Epoch 30/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3469 - val_loss: 0.5280
Epoch 31/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3457 - val_loss: 0.5383
Epoch 32/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3457 - val_loss: 0.5107
Epoch 33/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3414 - val_loss: 0.5114
Epoch 34/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3385 - val_loss: 0.4998
Epoch 35/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3380 - val_loss: 0.5084
Epoch 36/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3342 - val_loss: 0.4969
Epoch 37/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3340 - val_loss: 0.5037
Epoch 38/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3306 - val_loss: 0.4816
Epoch 39/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3292 - val_loss: 0.5135
Epoch 40/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3257 - val_loss: 0.4859
Epoch 41/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3227 - val_loss: 0.4924
Epoch 42/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3188 - val_loss: 0.4978
Epoch 43/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3145 - val_loss: 0.4912
Epoch 44/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3113 - val_loss: 0.4733
```

```
Epoch 45/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3075 - val_loss: 0.4737
Epoch 46/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3043 - val_loss: 0.4686
Epoch 47/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2972 - val_loss: 0.4601
Epoch 48/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2981 - val_loss: 0.4548
Epoch 49/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2942 - val_loss: 0.4782
Epoch 50/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2852 - val_loss: 0.4849
Epoch 51/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2891 - val_loss: 0.4634
Epoch 52/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2799 - val_loss: 0.5662
Epoch 53/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2798 - val_loss: 0.4484
Epoch 54/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2787 - val_loss: 0.4557
Epoch 55/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2665 - val_loss: 0.4308
Epoch 56/100
50/50 [==============================] - 6s 130ms/step - loss: 0.2723 - val_loss: 0.4508
Epoch 57/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2615 - val_loss: 0.4197
Epoch 58/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2591 - val_loss: 0.4340
Epoch 59/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2556 - val_loss: 0.4441
Epoch 60/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2632 - val_loss: 0.4298
Epoch 61/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2507 - val_loss: 0.4324
Epoch 62/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2508 - val_loss: 0.4387
Epoch 63/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2683 - val_loss: 0.4700
Epoch 64/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2541 - val_loss: 0.4403
Epoch 65/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2466 - val_loss: 0.4285
Epoch 66/100
50/50 [==============================] - 5s 109ms/step - loss: 0.2708 - val_loss: 0.4548
Epoch 67/100
```

```
50/50 [==============================] - 5s 107ms/step - loss: 0.2460 - val_loss: 0.4608
Epoch 68/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2435 - val_loss: 0.4430
Epoch 69/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3114 - val_loss: 0.7606
Epoch 70/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3064 - val_loss: 0.4607
Epoch 71/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2435 - val_loss: 0.4436
Epoch 72/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2431 - val_loss: 0.4450
Epoch 73/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2406 - val_loss: 0.4467
Epoch 74/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2414 - val_loss: 0.4466
Epoch 75/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2398 - val_loss: 0.4642
Epoch 76/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2403 - val_loss: 0.4695
Epoch 77/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3449 - val_loss: 0.7768
Epoch 78/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3255 - val_loss: 0.4606
Epoch 79/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2430 - val_loss: 0.4587
Epoch 80/100
50/50 [==============================] - 5s 102ms/step - loss: 0.2397 - val_loss: 0.4668
Epoch 81/100
50/50 [==============================] - 5s 105ms/step - loss: 0.2377 - val_loss: 0.4732
Epoch 82/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2376 - val_loss: 0.4610
Epoch 83/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2370 - val_loss: 0.4588
Epoch 84/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2422 - val_loss: 0.4607
Epoch 85/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2369 - val_loss: 0.4729
Epoch 86/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2338 - val_loss: 0.4714
Epoch 87/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2352 - val_loss: 0.6904
Epoch 88/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4762 - val_loss: 0.7905
Epoch 89/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4370 - val_loss: 0.7194
```

Epoch 90/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3293 - val_loss: 0.5197
Epoch 91/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2776 - val_loss: 0.4766
Epoch 92/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2599 - val_loss: 0.4635
Epoch 93/100
50/50 [==============================] - 5s 103ms/step - loss: 0.2511 - val_loss: 0.4595
Epoch 94/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2473 - val_loss: 0.4535
Epoch 95/100
50/50 [==============================] - 5s 104ms/step - loss: 0.2542 - val_loss: 0.4566
Epoch 96/100
50/50 [==============================] - 5s 107ms/step - loss: 0.2523 - val_loss: 0.4625
Epoch 97/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2484 - val_loss: 0.4627
Epoch 98/100
50/50 [==============================] - 5s 106ms/step - loss: 0.2460 - val_loss: 0.4727
Epoch 99/100
50/50 [==============================] - 5s 108ms/step - loss: 0.2437 - val_loss: 0.4522
Epoch 100/100
50/50 [==============================] - 6s 110ms/step - loss: 0.2437 - val_loss: 0.4554

Multi-Step Training and validation loss for WI_1

Multi_step LSTM for WI_1

Tail of Multi_step LSTM for WI_1
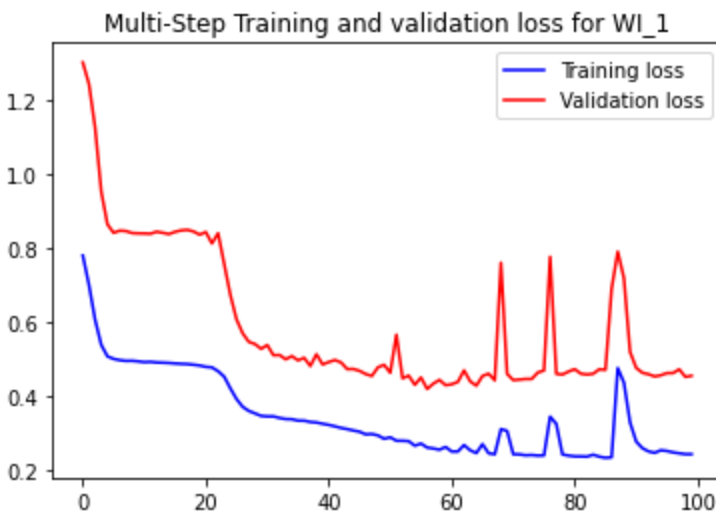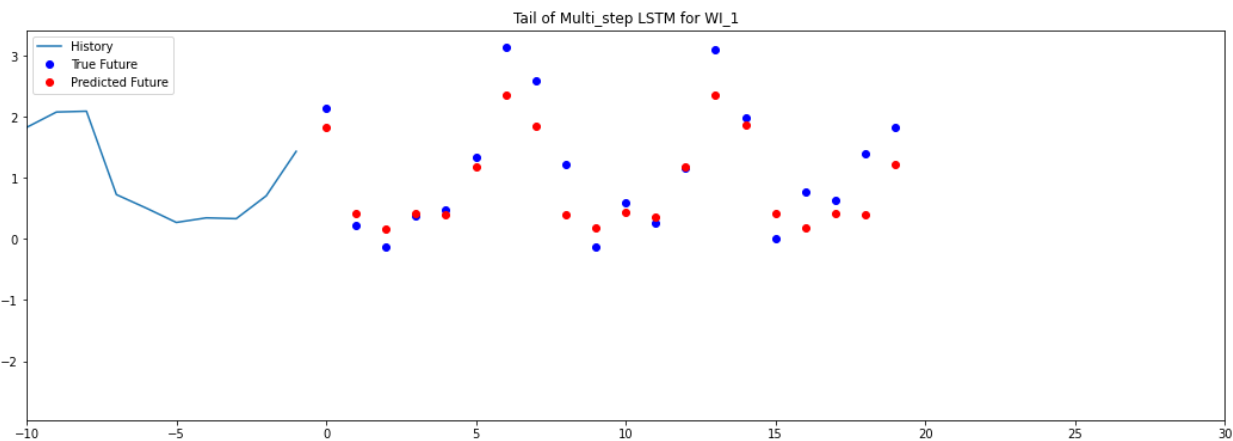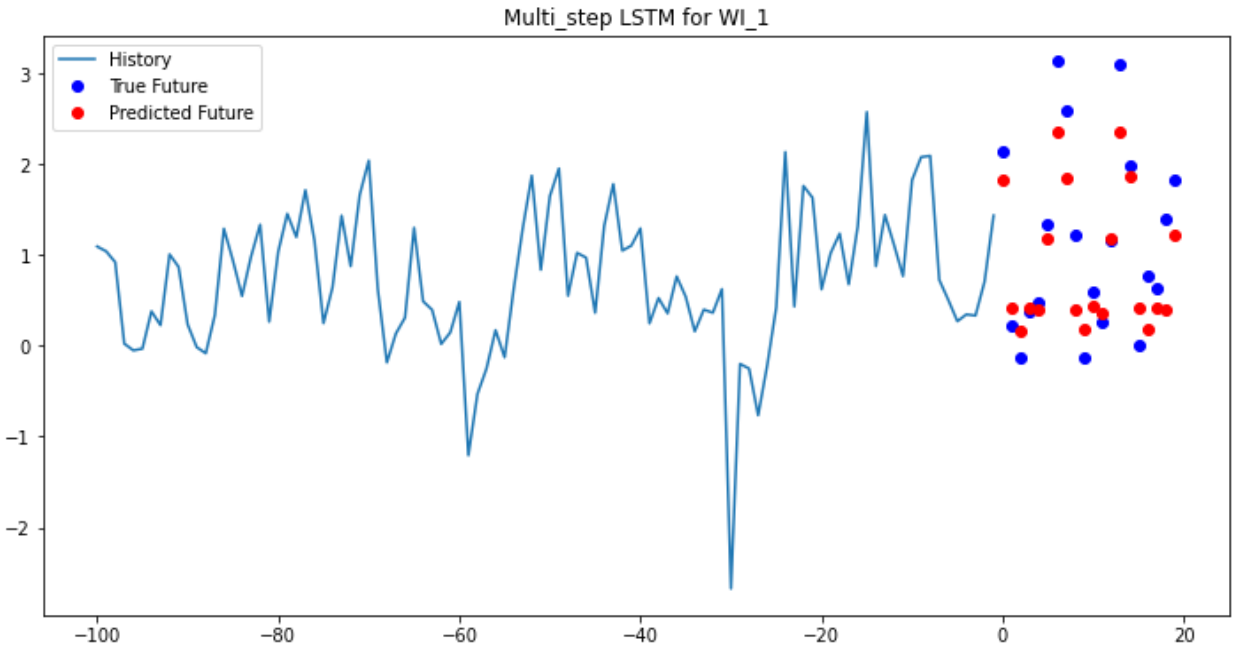
WI_1 - True Future: [4600. 2798. 2466. 2937. 3036. 3845. 5538. 5034. 3740. 2460. 3135. 2831.
 3676. 5516. 4461. 2597. 3313. 3180. 3899. 4308.]
WI_1 - Model Prediction: [4310.2715 2983.3425 2737.6787 2981.6382 2965.219 3707.191
4811.2847
 4334.308 2963.6724 2758.8896 2990.209 2929.9932 3695.1343 4813.5977
 4347.0195 2970.8225 2758.9194 2972.2407 2958.5874 3730.6013]
WI_1 - Model Percentage Error: [6.29844599 6.62410755 11.01697936 1.51985644 2.33139018
3.58411137
 13.12234258 13.8993225 20.75742344 12.14998571 4.61853319 3.49675606
  0.52051897 12.73390761 2.55504301 14.39439776 16.72443605 6.53331061
 24.11932797 13.40294061]%
WI_1 - Model Mean Percentage Error: 9.52015684809463%
===================================
===================================
Training for WI_2

Single window of past history : (100, 3)
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 113ms/step - loss: 0.7906 - val_loss: 1.6185
Epoch 2/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7009 - val_loss: 1.5467
Epoch 3/100
50/50 [==============================] - 5s 100ms/step - loss: 0.5752 - val_loss: 1.4176
Epoch 4/100
50/50 [==============================] - 5s 102ms/step - loss: 0.5094 - val_loss: 1.2662
Epoch 5/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4881 - val_loss: 1.2210
Epoch 6/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4844 - val_loss: 1.2284
Epoch 7/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4789 - val_loss: 1.2437
Epoch 8/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4773 - val_loss: 1.2590
Epoch 9/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4737 - val_loss: 1.2682
Epoch 10/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4729 - val_loss: 1.2798
Epoch 11/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4705 - val_loss: 1.2896
Epoch 12/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4673 - val_loss: 1.2905
Epoch 13/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4619 - val_loss: 1.2895
Epoch 14/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4536 - val_loss: 1.2618
Epoch 15/100
50/50 [==============================] - 5s 110ms/step - loss: 0.4421 - val_loss: 1.1910
Epoch 16/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4356 - val_loss: 1.1597
Epoch 17/100
50/50 [==============================] - 5s 101ms/step - loss: 0.4271 - val_loss: 1.1316
Epoch 18/100
50/50 [==============================] - 5s 104ms/step - loss: 0.4203 - val_loss: 1.1048
Epoch 19/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4113 - val_loss: 1.0909
Epoch 20/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4015 - val_loss: 1.0605
Epoch 21/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3937 - val_loss: 1.0443
Epoch 22/100

```
50/50 [==============================] - 5s 103ms/step - loss: 0.3870 - val_loss: 1.0280
Epoch 23/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3830 - val_loss: 1.0225
Epoch 24/100
50/50 [==============================] - 7s 138ms/step - loss: 0.3788 - val_loss: 0.9985
Epoch 25/100
50/50 [==============================] - 6s 119ms/step - loss: 0.3776 - val_loss: 1.0062
Epoch 26/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3747 - val_loss: 0.9376
Epoch 27/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3730 - val_loss: 0.9423
Epoch 28/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3714 - val_loss: 0.9026
Epoch 29/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3704 - val_loss: 0.9316
Epoch 30/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3678 - val_loss: 0.9269
Epoch 31/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3665 - val_loss: 0.8500
Epoch 32/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3655 - val_loss: 0.9192
Epoch 33/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3643 - val_loss: 0.8676
Epoch 34/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3630 - val_loss: 0.8324
Epoch 35/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3631 - val_loss: 0.8321
Epoch 36/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3614 - val_loss: 0.8457
Epoch 37/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3602 - val_loss: 0.8742
Epoch 38/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3583 - val_loss: 0.8476
Epoch 39/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3582 - val_loss: 0.8466
Epoch 40/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3561 - val_loss: 0.8101
Epoch 41/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3571 - val_loss: 0.7990
Epoch 42/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3539 - val_loss: 0.7961
Epoch 43/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3543 - val_loss: 0.7896
Epoch 44/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3530 - val_loss: 0.8324
```

```
Epoch 45/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3525 - val_loss: 0.8218
Epoch 46/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3526 - val_loss: 0.8062
Epoch 47/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3511 - val_loss: 0.8040
Epoch 48/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3504 - val_loss: 0.7593
Epoch 49/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3504 - val_loss: 0.7778
Epoch 50/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3495 - val_loss: 0.7958
Epoch 51/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3483 - val_loss: 0.7956
Epoch 52/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3485 - val_loss: 0.7542
Epoch 53/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3473 - val_loss: 0.8168
Epoch 54/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3456 - val_loss: 0.7749
Epoch 55/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3467 - val_loss: 0.7573
Epoch 56/100
50/50 [==============================] - 6s 110ms/step - loss: 0.3454 - val_loss: 0.7786
Epoch 57/100
50/50 [==============================] - 6s 113ms/step - loss: 0.3449 - val_loss: 0.8180
Epoch 58/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3446 - val_loss: 0.7843
Epoch 59/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3438 - val_loss: 0.8006
Epoch 60/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3429 - val_loss: 0.7846
Epoch 61/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3438 - val_loss: 0.7855
Epoch 62/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3430 - val_loss: 0.7820
Epoch 63/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3418 - val_loss: 0.7612
Epoch 64/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3424 - val_loss: 0.7567
Epoch 65/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3414 - val_loss: 0.8162
Epoch 66/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3416 - val_loss: 0.7914
Epoch 67/100
```

```
50/50 [==============================] - 5s 109ms/step - loss: 0.3416 - val_loss: 0.7557
Epoch 68/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3392 - val_loss: 0.7504
Epoch 69/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3405 - val_loss: 0.7193
Epoch 70/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3398 - val_loss: 0.8065
Epoch 71/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3401 - val_loss: 0.7752
Epoch 72/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3389 - val_loss: 0.7820
Epoch 73/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3379 - val_loss: 0.8024
Epoch 74/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3388 - val_loss: 0.7890
Epoch 75/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3383 - val_loss: 0.7540
Epoch 76/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3368 - val_loss: 0.7815
Epoch 77/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3374 - val_loss: 0.7472
Epoch 78/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3365 - val_loss: 0.7721
Epoch 79/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3360 - val_loss: 0.8024
Epoch 80/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3350 - val_loss: 0.7929
Epoch 81/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3358 - val_loss: 0.7450
Epoch 82/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3346 - val_loss: 0.7432
Epoch 83/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3339 - val_loss: 0.8172
Epoch 84/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3328 - val_loss: 0.8039
Epoch 85/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3326 - val_loss: 0.8483
Epoch 86/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3319 - val_loss: 0.9043
Epoch 87/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3310 - val_loss: 0.7367
Epoch 88/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3295 - val_loss: 0.8644
Epoch 89/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3287 - val_loss: 0.7899
```

```
Epoch 90/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3282 - val_loss: 0.8418
Epoch 91/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3266 - val_loss: 0.7996
Epoch 92/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3239 - val_loss: 0.8061
Epoch 93/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3228 - val_loss: 0.8283
Epoch 94/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3221 - val_loss: 0.8094
Epoch 95/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3178 - val_loss: 0.9006
Epoch 96/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3171 - val_loss: 0.9066
Epoch 97/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3159 - val_loss: 0.8902
Epoch 98/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3144 - val_loss: 0.9091
Epoch 99/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3122 - val_loss: 0.8527
Epoch 100/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3108 - val_loss: 0.8948
```


Multi-Step Training and validation loss for WI_2

Multi_step LSTM for WI_2

Tail of Multi_step LSTM for WI_2
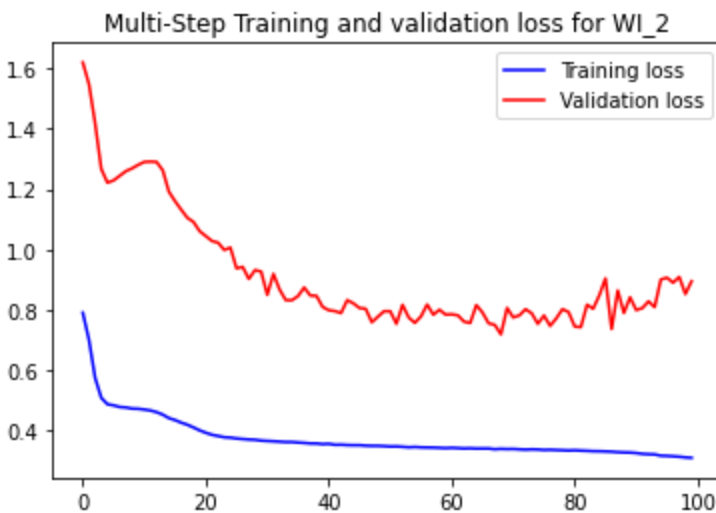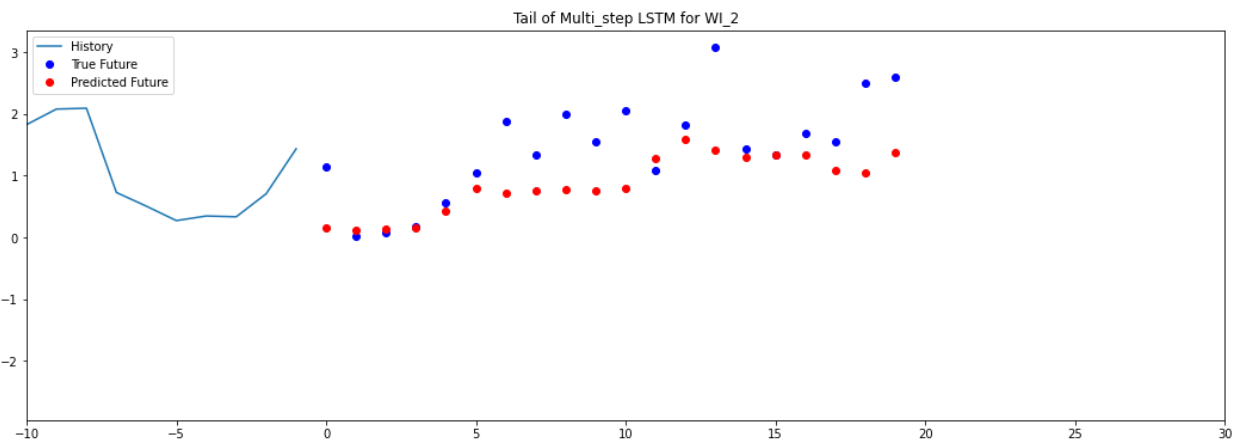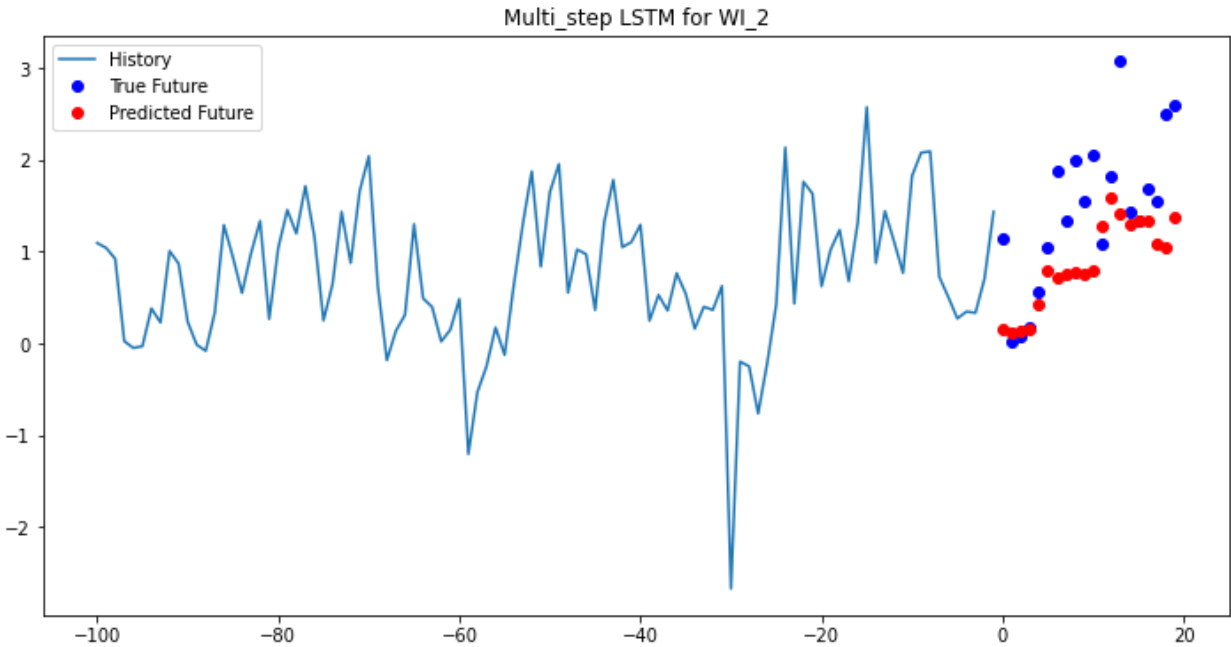
WI_2 - True Future: [4670. 3301. 3386. 3500. 3961. 4569. 5586. 4915. 5718. 5169. 5786. 4607.
5506. 7046. 5046. 4907. 5358. 5180. 6333. 6463.]

WI_2 - Model Prediction: [3474.998 3433.2012 3441.1946 3463.706 3796.8137 4265.2695 4169.04
4202.9717 4230.1953 4212.117 4263.8496 4846.644 5229.148 5017.902
4862.1655 4918.5176 4921.1846 4614.0713 4569.948 4959.3433]

WI_2 - Model Percentage Error: [25.58890692 4.00488252 1.63008211 1.03696987 4.14507143
6.64763556
25.36627213 14.48684273 26.01966925 18.51195226 26.30747305 5.20173742
5.02818835 28.78368073 3.64317227 0.2347173   8.15258361 10.92526469
27.83912455 23.26561563]%

WI_2 - Model Mean Percentage Error: 13.34099211875505%

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Training for WI_3
Single window of past history : (100, 3)

```
(72, 20)
Epoch 1/100
50/50 [==============================] - 6s 114ms/step - loss: 0.7924 - val_loss: 1.0317
Epoch 2/100
50/50 [==============================] - 5s 106ms/step - loss: 0.7825 - val_loss: 1.0646
Epoch 3/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7740 - val_loss: 1.1016
Epoch 4/100
50/50 [==============================] - 5s 100ms/step - loss: 0.7668 - val_loss: 1.1485
Epoch 5/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7624 - val_loss: 1.1850
Epoch 6/100
50/50 [==============================] - 5s 106ms/step - loss: 0.7540 - val_loss: 1.1632
Epoch 7/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7444 - val_loss: 1.0684
Epoch 8/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7407 - val_loss: 1.0556
Epoch 9/100
50/50 [==============================] - 5s 103ms/step - loss: 0.7329 - val_loss: 1.0433
Epoch 10/100
50/50 [==============================] - 5s 100ms/step - loss: 0.7302 - val_loss: 1.0260
Epoch 11/100
50/50 [==============================] - 5s 104ms/step - loss: 0.7259 - val_loss: 1.0143
Epoch 12/100
50/50 [==============================] - 5s 106ms/step - loss: 0.7253 - val_loss: 1.0016
Epoch 13/100
50/50 [==============================] - 6s 120ms/step - loss: 0.7232 - val_loss: 1.0032
Epoch 14/100
50/50 [==============================] - 6s 127ms/step - loss: 0.7203 - val_loss: 0.9996
Epoch 15/100
50/50 [==============================] - 6s 110ms/step - loss: 0.7182 - val_loss: 0.9901
Epoch 16/100
50/50 [==============================] - 6s 113ms/step - loss: 0.7142 - val_loss: 0.9806
Epoch 17/100
50/50 [==============================] - 6s 111ms/step - loss: 0.7115 - val_loss: 0.9746
Epoch 18/100
50/50 [==============================] - 6s 110ms/step - loss: 0.7065 - val_loss: 0.9562
Epoch 19/100
50/50 [==============================] - 5s 107ms/step - loss: 0.7005 - val_loss: 0.9241
Epoch 20/100
50/50 [==============================] - 6s 113ms/step - loss: 0.6908 - val_loss: 0.9283
Epoch 21/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6811 - val_loss: 0.9374
Epoch 22/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6712 - val_loss: 0.9457
```

```
Epoch 23/100
50/50 [==============================] - 5s 110ms/step - loss: 0.6626 - val_loss: 0.9453
Epoch 24/100
50/50 [==============================] - 6s 112ms/step - loss: 0.6528 - val_loss: 0.9347
Epoch 25/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6441 - val_loss: 0.9240
Epoch 26/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6380 - val_loss: 0.9137
Epoch 27/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6323 - val_loss: 0.9077
Epoch 28/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6259 - val_loss: 0.9105
Epoch 29/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6204 - val_loss: 0.9008
Epoch 30/100
50/50 [==============================] - 5s 104ms/step - loss: 0.6153 - val_loss: 0.8888
Epoch 31/100
50/50 [==============================] - 5s 106ms/step - loss: 0.6128 - val_loss: 0.8867
Epoch 32/100
50/50 [==============================] - 5s 109ms/step - loss: 0.6070 - val_loss: 0.8735
Epoch 33/100
50/50 [==============================] - 5s 107ms/step - loss: 0.6038 - val_loss: 0.8703
Epoch 34/100
50/50 [==============================] - 5s 110ms/step - loss: 0.6008 - val_loss: 0.8623
Epoch 35/100
50/50 [==============================] - 7s 133ms/step - loss: 0.5956 - val_loss: 0.8587
Epoch 36/100
50/50 [==============================] - 6s 115ms/step - loss: 0.5925 - val_loss: 0.8396
Epoch 37/100
50/50 [==============================] - 6s 111ms/step - loss: 0.5916 - val_loss: 0.8537
Epoch 38/100
50/50 [==============================] - 6s 113ms/step - loss: 0.5771 - val_loss: 0.8438
Epoch 39/100
50/50 [==============================] - 5s 109ms/step - loss: 0.5716 - val_loss: 0.7898
Epoch 40/100
50/50 [==============================] - 5s 106ms/step - loss: 0.5413 - val_loss: 0.7415
Epoch 41/100
50/50 [==============================] - 5s 105ms/step - loss: 0.5123 - val_loss: 0.7402
Epoch 42/100
50/50 [==============================] - 5s 103ms/step - loss: 0.4777 - val_loss: 0.7123
Epoch 43/100
50/50 [==============================] - 5s 105ms/step - loss: 0.4583 - val_loss: 0.6380
Epoch 44/100
50/50 [==============================] - 6s 110ms/step - loss: 0.4392 - val_loss: 0.6395
Epoch 45/100
```

```
50/50 [==============================] - 6s 110ms/step - loss: 0.4300 - val_loss: 0.6664
Epoch 46/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4242 - val_loss: 0.6491
Epoch 47/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4185 - val_loss: 0.6934
Epoch 48/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4149 - val_loss: 0.6797
Epoch 49/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4119 - val_loss: 0.6251
Epoch 50/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4089 - val_loss: 0.6549
Epoch 51/100
50/50 [==============================] - 5s 109ms/step - loss: 0.4089 - val_loss: 0.6133
Epoch 52/100
50/50 [==============================] - 5s 107ms/step - loss: 0.4048 - val_loss: 0.6588
Epoch 53/100
50/50 [==============================] - 5s 106ms/step - loss: 0.4035 - val_loss: 0.6429
Epoch 54/100
50/50 [==============================] - 5s 108ms/step - loss: 0.4027 - val_loss: 0.6281
Epoch 55/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3998 - val_loss: 0.6186
Epoch 56/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3987 - val_loss: 0.6212
Epoch 57/100
50/50 [==============================] - 5s 110ms/step - loss: 0.3972 - val_loss: 0.6473
Epoch 58/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3971 - val_loss: 0.6413
Epoch 59/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3953 - val_loss: 0.7398
Epoch 60/100
50/50 [==============================] - 6s 111ms/step - loss: 0.3950 - val_loss: 0.6726
Epoch 61/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3929 - val_loss: 0.6226
Epoch 62/100
50/50 [==============================] - 5s 109ms/step - loss: 0.3904 - val_loss: 0.6478
Epoch 63/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3909 - val_loss: 0.6257
Epoch 64/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3895 - val_loss: 0.6727
Epoch 65/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3887 - val_loss: 0.7105
Epoch 66/100
50/50 [==============================] - 5s 108ms/step - loss: 0.3864 - val_loss: 0.6920
Epoch 67/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3859 - val_loss: 0.6748
```

```
Epoch 68/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3844 - val_loss: 0.6825
Epoch 69/100
50/50 [==============================] - 6s 115ms/step - loss: 0.3830 - val_loss: 0.7024
Epoch 70/100
50/50 [==============================] - 6s 112ms/step - loss: 0.3844 - val_loss: 0.6567
Epoch 71/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3819 - val_loss: 0.7019
Epoch 72/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3819 - val_loss: 0.6909
Epoch 73/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3800 - val_loss: 0.6788
Epoch 74/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3801 - val_loss: 0.6807
Epoch 75/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3779 - val_loss: 0.6250
Epoch 76/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3775 - val_loss: 0.6716
Epoch 77/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3775 - val_loss: 0.6740
Epoch 78/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3762 - val_loss: 0.6438
Epoch 79/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3756 - val_loss: 0.6477
Epoch 80/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3732 - val_loss: 0.6818
Epoch 81/100
50/50 [==============================] - 5s 100ms/step - loss: 0.3746 - val_loss: 0.6753
Epoch 82/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3733 - val_loss: 0.6334
Epoch 83/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3707 - val_loss: 0.6546
Epoch 84/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3715 - val_loss: 0.6548
Epoch 85/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3703 - val_loss: 0.6725
Epoch 86/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3693 - val_loss: 0.6449
Epoch 87/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3681 - val_loss: 0.6085
Epoch 88/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3673 - val_loss: 0.6614
Epoch 89/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3680 - val_loss: 0.6169
Epoch 90/100
```

```
50/50 [==============================] - 5s 105ms/step - loss: 0.3644 - val_loss: 0.6027
Epoch 91/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3647 - val_loss: 0.6875
Epoch 92/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3634 - val_loss: 0.6462
Epoch 93/100
50/50 [==============================] - 5s 105ms/step - loss: 0.3628 - val_loss: 0.6208
Epoch 94/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3629 - val_loss: 0.5935
Epoch 95/100
50/50 [==============================] - 5s 106ms/step - loss: 0.3582 - val_loss: 0.6087
Epoch 96/100
50/50 [==============================] - 5s 102ms/step - loss: 0.3594 - val_loss: 0.5986
Epoch 97/100
50/50 [==============================] - 5s 101ms/step - loss: 0.3610 - val_loss: 0.6114
Epoch 98/100
50/50 [==============================] - 5s 107ms/step - loss: 0.3569 - val_loss: 0.6026
Epoch 99/100
50/50 [==============================] - 5s 104ms/step - loss: 0.3564 - val_loss: 0.6189
Epoch 100/100
50/50 [==============================] - 5s 103ms/step - loss: 0.3538 - val_loss: 0.6326
```


Multi-Step Training and validation loss for WI_3

Multi_step LSTM for WI_3

Tail of Multi_step LSTM for WI_3
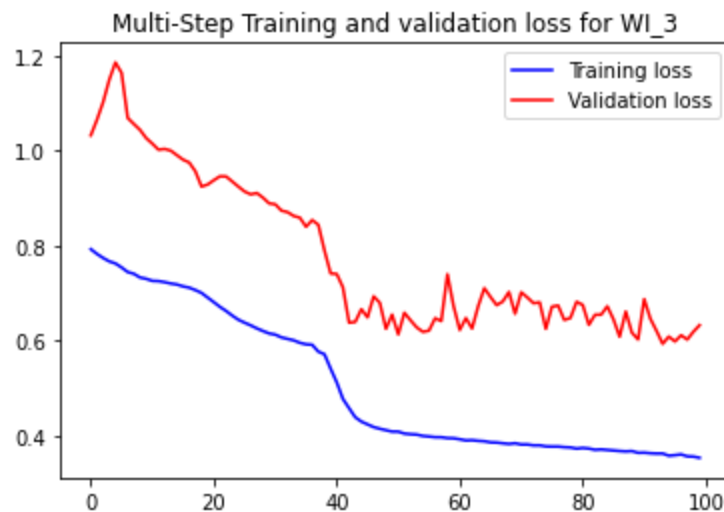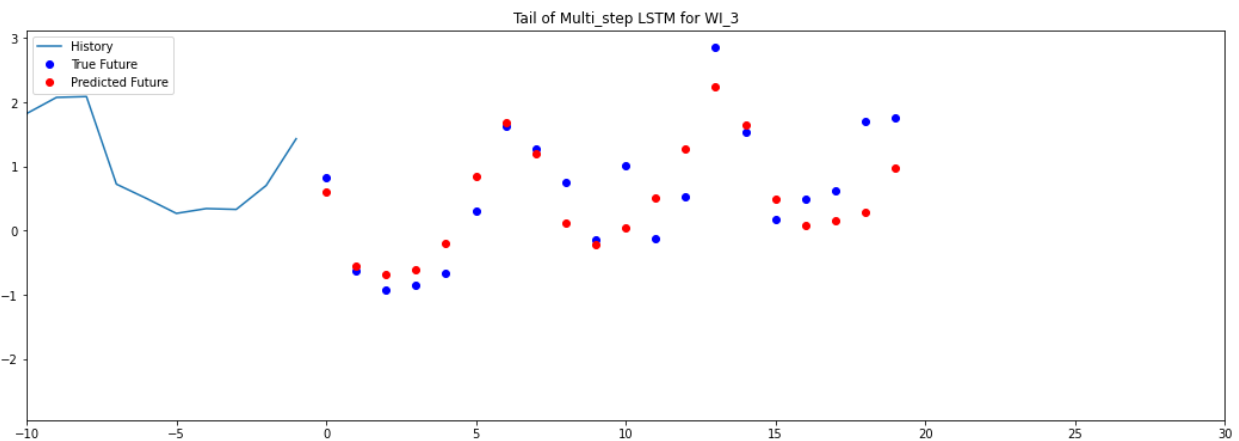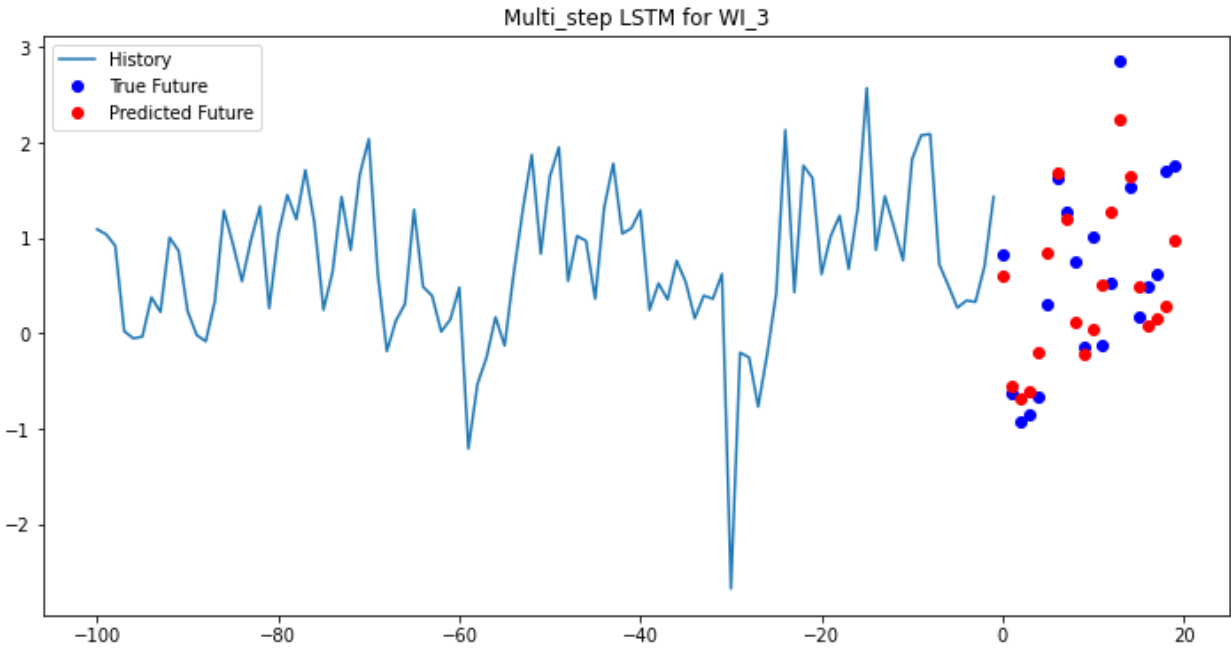
WI_3 - True Future: [3998. 2806. 2564. 2632. 2775. 3580. 4653. 4362. 3938. 3210. 4153. 3219.
 3756. 5657. 4577. 3468. 3728. 3833. 4721. 4759.]
WI_3 - Model Prediction: [3816.4016 2877.9614 2767.046 2826.7024 3158.4194 4018.0107
4699.878
 4303.8496 3428.5344 3152.6099 3355.1748 3734.5818 4373.82   5166.489
 4668.914 3727.595 3391.5715 3454.2507 3561.754 4119.8   ]
WI_3 - Model Percentage Error: [4.54223083 2.56455544 7.9191068   7.39750732 13.81691653
12.23493693
  1.00747753 1.33311304 12.93716547 1.78785473 19.21081616 16.01683091
 16.44887711 8.67087203 2.00817266 7.48543745 9.02436874 9.88127492
 24.55509625 13.43139725]%
WI_3 - Model Mean Percentage Error: 9.613700405018001%
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