PART—A   3×10=30

Instructions : (1) Answer **all** questions.

(2) Each question carries **three** marks.

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Draw the speed-time curve of main line service.

2. State three advantages of 25 kV AC system over DC system.

3. State the three components of tractive effort.

4. What is the difference between dead weight and effective weight of locomotive?

5. State any three methods of improving coefficient of adhesion.

6. State the purpose of dropper in electric traction.

7. List the time instructions of PLC.

8. Write a brief notes on NO and NC contacts.

9. State any three rules used in ladder diagram.

10. Draw the ladder diagram of OR gate.

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PART—B 10×5=50

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Instructions : (1) Answer *any* **five** questions.

(2) Each question carries **ten** marks.

(3) Answers should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11. The distance between two stations is 1 km and the schedule speed is 30 kmph, station stopping time 20 seconds. Assuming braking retardation 3 kmphps and maximum speed 1·25 times the average speed, determine the acceleration required to run the service, if the speed time curve is approximated by a trapezoidal curve.

12. An electric train weighing 200 tonnes has eight motors geared to driving wheel. Each wheel diameter is 90 cm. Determine the torque developed by each motor to accelerate the train to a speed of 48 kmph in 30 seconds up a gradient of 1 in 200. The tractive resistance is of 50 N/tonne, the effect of rotational inertia is 10% of the train weight, the gear ratio is 4 to 1 and gearing efficiency is 80%.

13. An electric train weighing 100 tonnes has a rotational inertia of 10%. This train while running between two stations which are 2·5 km apart has an average speed of 50 km/hr. The acceleration and retardation during braking are respectively 1 kmphps and 2 kmphps. The percentage gradient between these two stations is 1% and the train is to move up the incline. The track resistance is 40 N/tonne. If the combined efficiency of the train is 60%, determine *(a)* maximum power at the driving axle, *(b)* total energy consumption and *(c)* specific energy consumption. Assume that journey is to be made on simplified trapezoidal speed-time curve.

14. *(a)* Explain any 5 electrical characteristics required by a traction motor.   5

       (b) Explain the control of a.c. traction motor by auto-transformer.   5

15. *(a)* Explain the use of booster transformer in electric traction.   5

       (b) Explain the construction and working of pantograph collector.   5

16. *(a)* Distinguish relay-based and PLC-based control panels in any five aspects.   5

       (b) Draw the ladder diagram of star-delta starter.   5

17. Write short notes on the following :   5+5

       (a) Proximity switches

       (b) Reed switches

18. *(a)* What is SCADA? State its importance.   5

       (b) List various SCADA softwares used with PLC.   5

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