TEST ID: 508

ACE
Engineering Academy

Head Office : Sree Sindhi Guru Sangat Sabha Association, # 4-1-1236/1/A, King Koti, Abids, Hyderabad – 500001.
Ph: 040-23234418, 040-23234419, 040-23234420, 040 - 24750437
Hyderabad | Delhi | Bhopal | Pune | Bhubaneswar | Lucknow | Patna | Bengaluru | Chennai | Vijayawada | Vizag | Tirupati | Kukatpally | Kolkata | Ahmedabad

# ESE- 2019 (Prelims) - Offline Test Series Test- 15

## CIVIL ENGINEERING

## SUBJECT: ENVIRONMENTAL ENGINEERING, TRANSPORTATION ENGINEERING,GEO-TECHNICAL ENGINEERING AND FOUNDATION ENGINEERING

**01. Ans: (d)**

**Sol:** Available $Cl_2$ in bleaching powder = 0.3 mg/ml

$Cl_2$ dose = 0.1 mg/lit

Water amount = 200 ml

$$\therefore \text{Cl}_2 \text{ dose} = \left(0.1 \times \frac{200}{1000}\right) \text{mg}$$

$$\therefore \text{ BP dose } = \frac{\text{Cl}_2 \text{ dose}}{\%\ \text{Cl}_2 \text{ available}}$$

$$= \frac{0.1 \times 200}{1000} \times \frac{1}{0.3} \text{ ml}$$

**02. Ans: (c)**

**Sol:** In second 20 year road plan or Bombay Road plan

- Area is divided into three parts i.e

(a) Developed and agricultural area

(b) Semi developed area

(c) Undeveloped and uncultivated area

- Length of the railway track is considered independent of the road system and hence it is not subtracted to get the road length
- Expressways were considered in this plan and 1600 kms of the expressways were proposed

**Note:** In Nagpur road plan, area is divided into two parts i.e., agricultural and non agricultural areas

**03. Ans: (c)**

**Sol:** According to Mohr's theory, the failure envelope is a curved

**04. Ans: (b)**

**Sol:** Influent valve and filtered water outlet valve has to be closed.

**05. Ans: (b)**

**Sol:** Resisting length is the effective horizontal length of the highway that is required considering the total work to be done i.e. against resistance to move a vehicle along the road.

Generally in case of hill roads, to connect two station A and B (which are at an elevation difference of 'h' ) the shortest horizontal length($L_o$) of the road is not adopted as it results in a gradient steeper than the ruling gradient.

When the ruling gradient is adopted, as shown in the figure, the length required is $L_1 = L_o + l_1$. But in practice it is not possible to strictly follow uniform gradient throughout the road from economy considerations (i.e filling and cutting etc). Hence, rises and falls occurs as in case 'C' and length of the road required is $L_2 = L_0 + l_2$

Work done for moving from A to B in case I $= WfL_o + Wh = WfL_r$

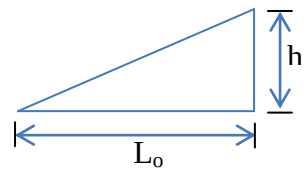
Resisting length $L_r = L_o + (h/f)$

Similarly in case II, $L_r = L_o + l_1 + (h/f)$

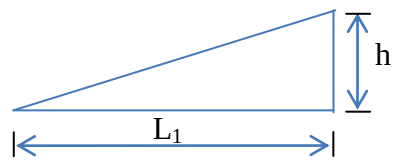
In case 3, assuming the net effective rise and fall as $h_3$ ; $L_r = L_o + l_2 + (h+h_3/f)$

As the length of road increase, cost increases. Hence resisting length has to be kept as minimum as possible eliminating the unnecessary rise and fall.

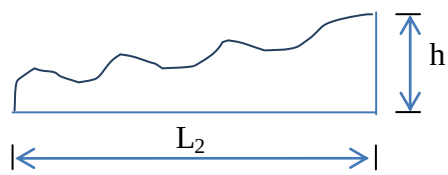
**Case I :**




**Case II:**




**Case III:**




**06. Ans: (b)**

**07. Ans: (b)**

**Sol:** We know that

$$T_v = \frac{\pi}{4}\left(\frac{U\%}{100}\right)^2, \qquad T_v = \frac{C_v t}{d^2}$$

$$(U\%)^2 \propto t$$

$(40\%)^2 \rightarrow 178$ days

$(60\%)^2 \rightarrow ?$

For 60% consolidation

$$\frac{178\times 60^2}{40^2}=\frac{801}{2}\text{days}$$

For additional 20% consolidation

$$\frac{801}{2}-178=222.5\ \text{days}$$

**08. Ans: (b)**

**Sol:** Initial reaction time of the driver t = 2sec

Time for overtaking = $T=\sqrt{\frac{4S}{a}}$

$S = 0.2V_b + 6$ ( If $V_b$ is in kmph)

$= (0.2 \times 50) + 6 = 16m$

$T=\sqrt{\frac{4\times 16}{1}}=8\text{sec}$

Total time = 2+ 8 = 10sec

**09. Ans: (b)**

**Sol:** $BOD_5^{20^\circ C}=150\ mg/lit$ e = 2.72

$k^1 = 0.2\ day^{-1}$

$L_o=\frac{BOD_5^{20^\circ C}}{(1-e^{-k^1 t})}$ t = 5 days

$L_o$ = 237.2 mg/lit

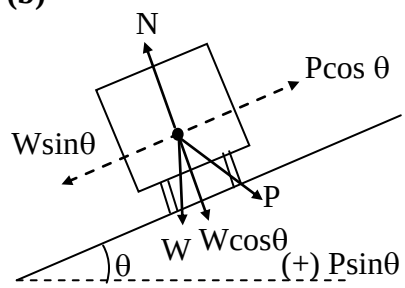
**10. Ans: (b)**

**Sol:**

- Fine grained soils include silts and clays. A quick condition is most likely to occur in fine sand.
- A quick sand condition also develop in gravel when discharge is more.
- A quick sand condition does not occur in cohesive soil as it has cohesion. Therefore quick sand does not occurs in clays.

**11. Ans: (b)**

**Sol:**




The forces acting on a passenger sitting in a vehicle traversing a horizontal curve of radius 'R' and suprelevation tanθ.

(i) self weight 'W'

(ii) centrifugal force $P=\frac{WV^2}{127R}$

Resolving the force along and perpendicular to the inclined plane.

Net force along the plane = P cos θ –W sin θ

**Note:** (Normal reaction (N)= P sin θ + W cos θ)

ACE

# SUMMER

## SHORT TERM BATCHES

## GATE+PSUs - 2020

Admissions Open From 14th NOV 2018

### HYDERABAD

29th April | 06th May | 11th May

18th May | 26th May | 02nd June 2019

### DELHI

11th May | 23rd May 2019

SHORT TERM BATCHES

Start Early.. Gain Surely...

## EARLY BIRD OFFER :

Register on or Before 31st December 2018 : 5000/- Off | Register on or Before 31st March 2019 : 3000/- Off

ACE

# TEST YOUR PREP

IN A REAL TEST ENVIRONMENT

## Pre GATE - 2019

Date of Exam : **20th January 2019**

Last Date to Apply : **31st December 2018**

**Highlights :**

* Get real-time experience of **GATE-2019** test pattern and environment.
* Virtual calculator will be enabled.
* Post exam learning analytics and All India Rank will be provided.
* Post GATE guidance sessions by experts.
* Encouraging awards for **GATE-2019** toppers.

**12. Ans: (b)**

**Sol:** $DT = \frac{V}{Q} = \frac{2500\ m^3}{2.5\times10^6\ lt/day}$

$= \frac{2500\ m^3}{25\times10^3 m^3}\times 24\ hr = \frac{24}{10} hr$

**13. Ans: (b)**

**Sol:** We know that , The vertical stress due to point load does not depends upon modulus of elasticity.It depends on load, depth, radial distance of the point.

**14. Ans: (b)**

**Sol:** Deviation angle N

$= \left|\left(\frac{-1}{20}\right) - \left(\frac{1}{40}\right)\right| = |-0.075| = 0.075$

Hence valley curve is provided.

Design speed V = 80kmph

Length of the curve = L = 200m

Impact factor

$= \frac{1.59NV^2}{L} = \frac{1.59\times0.075\times80^2}{200} = 3.816$

**15. Ans: (c)**

**Sol:** Critical depth of cut in a $\phi_u = 0$ soil is equal to $\frac{4c_u}{\gamma}$ since $k_a = 1$ for $\phi_u = 0$

$\therefore \frac{4c_u}{20} = 6$

$c_u = \frac{6\times20}{4} = 30\ kN/m^2$

**16. Ans: (a)**

**Sol:** $[pH]_A = 4 \qquad \left(H_A^+\right) = 10^{-4}\ mol/lt$

$[pH]_B = 5 \qquad \left(H_B^+\right) = 10^{-5}\ mol/lt$

$\frac{H_A^+}{H_B^+} = \frac{10^{-4}}{10^{-5}} = 10^1 = 10$

**17. Ans: (c)**

**18. Ans: (c)**

**Sol:** Collapsible soils are those soils that collapse without any additional loading because of wetting. When water gets entry into the soil, the structure collapses.

**19. Ans: (a)**

**Sol:** Speed and delay studies are carried out by

- Floating car method
- Interview technique
- Elevated observations
- Photographic technique
- License plate method.

**Note:** Mechanical counters are used for counting traffic volume.

**Note:** Contour lines are used for presenting Origin and Destination surveys

**20. Ans: (d)**

**Sol:** $w_L = 60\% = 0.60$

$w_p = 20\% = 0.20$

% clay soil = 80%

$C = 0.8$

$$A = \frac{I_p}{C} = \left(\frac{w_L - w_P}{C}\right)$$

$$= \left(\frac{0.60 - 0.20}{0.80}\right) = 0.5$$

**21. Ans: (a)**

**Sol:** V (terminal settling velocity)

= SOR (Surface overflow rate) as $\eta = 100\%$

$$SOR = \frac{Q}{SA} = \frac{2400\,m^3/day}{100\,m^2}$$

$$= \frac{2400}{100 \times 24} = 1\,m/hr$$

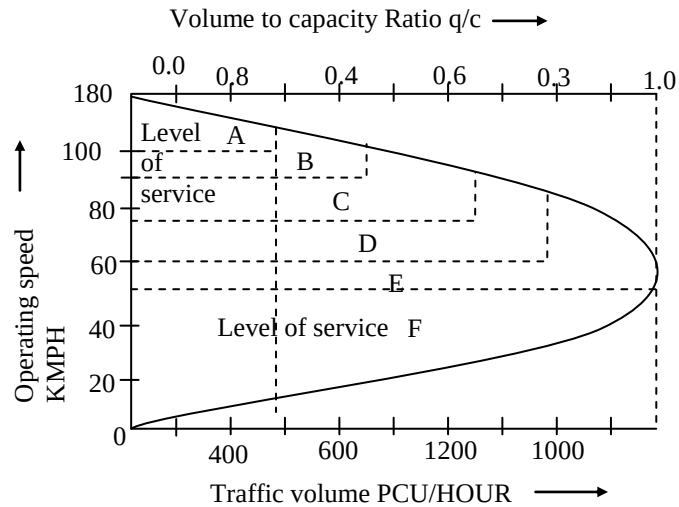
**22. Ans: (b)**

**Sol:** Capacity flow is the flow when all the vehicles flow as a stream at an optimum speed with no opportunity of over taking at that time of flow. At this optimum speed, volume to capacity ratio is 1.

At this condition, it leads to congestion and the level of service is low.

Level of service A exists when the volume to capacity ratio is so low that the users have the freedom to move at desired speeds i.e level of comfort and convenience to the passengers is extreme.

For constant, irrespective of the speed, the volume to capacity ratio is constant.




**23. Ans: (b)**

**Sol:** Manning's equation $\Rightarrow V = \frac{1}{n} R^{2/3} S^{1/2}$

Hazen willian equation $\Rightarrow V = KCR^{0.63}S^{0.54}$

Chezy's equation $\Rightarrow V = C\sqrt{RS}$

Darcy Weisbach $\Rightarrow \frac{H_f}{L} = \frac{f}{d}\left(\frac{v^2}{2g}\right)$

**24. Ans: (c)**

**Sol:**

| **Mineral** | **Specific Surface Area** |
|---|---|
| Montmorillonite | 1000 $m^2$/gm |
| Illite | 65-100 $m^2$/gm |
| Kaolinite | 10-20 $m^2$/gm |

**25. Ans: (a)**

**Sol:** Parking turnover is the ratio of number of vehicles parked to the number of parking bays available. It is expressed as number of vehicles per day per time duration.

Parking index is the number of bays occupied to the total space available

Average parking duration is the ratio of total vehicle hours to the number of vehicles parked.

Parking accumulation is the number of vehicles parked at a given instant of time.

**26. Ans: (d)**

**27. Ans: (b)**

**Sol:** $G_s = \frac{\gamma_s}{\gamma_w} = \frac{2.4}{1} = 2.4$

$$\gamma = \frac{\gamma_w G_s}{1+e}$$

$$1.8 = \frac{1 \times 2.4}{1+e}$$

$$e = \frac{2.4}{1.8} - 1 = 0.33$$

**28. Ans: (d)**

**Sol:** Effective green time = green time + amber time – lost time

= 30 + 5 – 3 -2 = 30 sec

Green ratio = 30/60 = 0.5

Traffic capacity of the lane = green ratio x (3600/h)

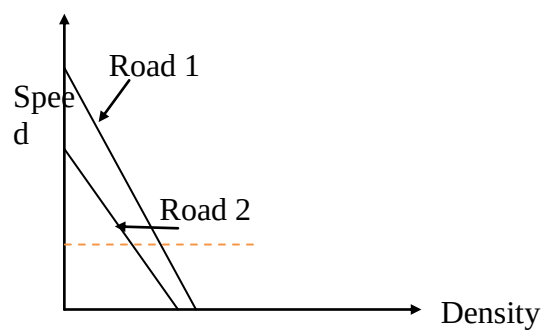
= 0.5 x ( 3600/3) = 600 veh/hr

**29. Ans: (d)**

**30. Ans:(b)**

**31. Ans: (a)**

**Sol:** If we consider same speed value for road 1 and road 2, as shown in the dotted line of the figure, it can be observed that road 1 has more density than road 2. Since, both the roads have same number of lanes, it can inferred that road 1 has lanes of more width than road 2




**32. Ans: (b)**

**33. Ans: (c)**


Launching

**Spark Batches** for

# ESE / GATE - 2020

from Mid May 2019

Admissions from **January 1st, 2019**

# @ DELHI

Launching

**Regular Batches** for

# ESE / GATE - 2020

from Mid May 2019

Admissions from **January 1st, 2019**

# @ BHOPAL & LUCKNOW

**34. Ans: (a)**

**Sol:** **Rutting:** It is the longitudinal depression on the wheel tracks

**Shoving:** It is the localised bulging of the pavement surface along with crescent shaped cracks

**Depression:** These are generally localised shallow deformation due to inadequate compaction

**Settlement:** These are large deformation in the pavements formed due to poor compation of fills, poor drainage, etc

**35. Ans: (b)**

**Sol:** P = 70,000; flow depth = 1.5 m

Avg. consumption = 150 *l*pcd

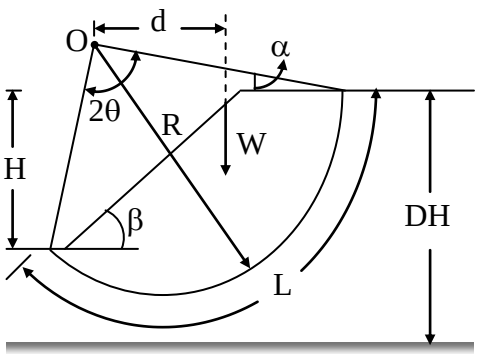
Canal runs for 10 hr

$$\text{Intake load} = \frac{70{,}000 \times 150 \times 10^{-3}\ \text{m}^3}{10 \times 3600}$$

$$= 0.29\ \text{m}^3/\text{sec}$$

**36. Ans: (a)**

**Sol:**




Given

H = 10 m; DH = 20 m ; $\beta = 30^o$

$\therefore$ D = 2 and $S_n = 0.172$

C = 50 kN/m$^2$ ; $\gamma$ = 25 kN/m$^3$

$$\text{F.O.S} = \frac{C}{S_n.\gamma.H}$$

$$= \frac{50}{0.172 \times 25 \times 10} = 1.16$$

**37. Ans: (a)**

**Sol:** In premix method aggregates and the bituminous binder are mixed thoroughly before spreading and compacting.

It includes

(a) Bituminous macadam

(b) Bituminous premix carpet

(c) Bituminous concrete

(d) Sheet asphalt

(e) Mastic asphalt

**Note:** Penetration macadam is a type of grouted construction.

**38. Ans: (c)**

**Sol:**

- The average permeability perpendicular to the bedding planes,

$$k_y = \frac{z_1 + z_2 + z_3}{\frac{z_1}{k_1} + \frac{z_2}{k_2} + \frac{z_3}{k_3}}$$

$$= \frac{2\times10^2\times3}{\frac{2\times10^2}{2\times10^{-8}}+\frac{2\times10^2}{0.5\times10^{-8}}+\frac{2\times10^2}{4\times10^{-8}}}$$

$$k_y = \frac{3\times10^{-8}}{\frac{1}{2}+2+\frac{1}{4}}$$

$k_y = 1.09\times10^{-8}$ cm/s

- The average permeability parallel to the bedding planes,

$$k_x = \frac{k_1z_1 + k_2z_2 + k_3z_3}{z_1 + z_2 + z_3}$$

$$= \left(\frac{2\times2 + 0.5\times2 + 4\times2}{6\times10^2}\right)\times10^{-8}\times10^2$$

$= 2.16\times10^{-8}$ cm/s

- Consolidation test is the most suitable test for soils with permeability less then $10^{-6}$ cm/sec

**39. Ans: (d)**

**Sol:** $\frac{21.48}{35.5}\times100 = 60.5\%$

**40. Ans: (d)**

**Sol:** Bitumen cutbacks are available in three types

- Rapid curing (RC)
- Medium curing (MC)
- Slow curing (SC)

The grade of the cutback is designated by number like RC-4 , MC-2 etc

The cutback with lowest viscosity is designated by 0 as RC-0, MC-0, SC-0 and as the suffix number increases, the viscosity increases the highest number being 5. This number indicates a definite viscosity irrespective of the type of cutback. Hence RC-3,MC-3, SC-3 all have same viscosity.

Therefore from the given option MC-5 has highest viscosity.

**41. Ans: (c)**

**Sol:** $p_w = \pi D\frac{\theta}{360}$ $\quad \frac{d}{D} = \frac{1}{2}(1-\cos\frac{\theta}{2})$

$p_w = \pi D.\frac{120}{360}$ $\quad \frac{D/4}{D} = \frac{1}{2}(1-\cos\theta/2)$

$= \frac{\pi D}{3}$ $\quad 1-\cos\frac{\theta}{2} = \frac{1}{2}$

$\cos\frac{\theta}{2} = \frac{1}{2}$ $\quad \theta = 120^o$

**42. Ans: (d)**

**43. Ans: (c)**

Let the total weight of the mix is 'W'gm and the total volume is 'V'cc.

Volume of aggregates = $V_{agg}$

= 0.945W/2.7 = 0.35W

% weight of bitumen = 100 – 94.5 = 5.5%

Volume of bitumen = $V_{bit}$ = 0.0505W/1

= 0.0505W

Volume of air voids = 0.1V

Total volume V = $V_{agg} + V_{bit} + V_{air}$

V = 0.35W + 0.0505W + 0.1V

0.9V = 0.4W

W/V = 0.9/0.4 = 2.25

**44. Ans: (b)**

**45. Ans : (c)**

**46. Ans: (b)**

**Sol:** Vehicle damage factor

$$= \left(\frac{\text{axle load}}{\text{sandard axle load}}\right)^4$$

Vehicle damage factor $\propto (\text{axle load})^4$

$$\frac{VDF_1}{VDF_2} = \left(\frac{10}{8}\right)^4 = 2.44$$

**47. Ans: (c)**

**48. Ans: (c)**

**Sol:** Westergaard equation

$$\sigma_z = \frac{Q}{Z^2} \times \frac{\frac{1}{\pi}}{[1+2(r/z)]^{3/2}}$$

**49. Ans: (c)**

**Sol:** Joint filler can compress up to 60% of its thickness. Expansion in concrete is = 0.6 x 2.5 = 1.5cm

Temperature difference = 55-15 = $40^oC$

Spacing between expansion joint

$L = \delta/(100 \times \alpha \times \Delta T)$

$= 1.5/(100 \times 10 \times 10^{-6} \times 40) = 37.5m$

**50. Ans: (d)**

**51. Ans: (b)**

**Sol:** Combination of fish plates, bolts and nuts are used to connect rails together.

For joining rail to wooden sleepers, Dog spikes, fang bolts, screw spikes, and bearing plates are used.

For joining rail to cast iron sleepers Tie bars and cotters are used.

**52. Ans: (d)**

**53. Ans: (c)**

**54. Ans: (b)**

**Sol:** Maximum cant deficiency for BG track is 7.5cm

Actual cant for main track is 8.2 – 7.5

= 0.7cm

Actual cant for main track is -0.7cm

**55. Ans: (c)**

**56. Ans: (d)**

**Sol:** Gauge of the railway track is affected by

- Cost of construction
- Volume and nature of traffic
- Development of area
- Physical features of the country
- Speed of the movement

**57. Ans: (a)**

**58. Ans: (a)**

**Sol:** Effective gradient is the difference in elevation between the highest and lowest points of the runway dived by the total length of the runway

$$= \frac{101.2 - 99.2}{1000} \times 100 = 0.2\%$$

**59. Ans: (b)**

**60. Ans: (b)**

**Sol:** Windrose diagram is mainly used for runway orientation. It gives the direction of the head wind which affects the length of the runway.

**61. Ans: (b)**

**Sol:** 1200 vehicle emitting 40gm/sec of CO

Total CO emitted =1200×40=48000 gm/sec

In 1hr 80 km length is covered

CO emissions per unit length=48000/80=600 gm/sec=600/1000=0.6gm/ms

where ms(millisecond)

**62. Ans: (d)**

**Sol:** In Full face method of tunnelling in rocks, the amount of equipment required is minimum. Total magnitude of ground disturbance and settlement is also minimum.

**63. Ans: (b)**

**64. Ans: (d)**

**65. Ans: (c)**

**66. Ans: (d)**

**Sol:** In case of a hump, the problem of sight distance does not arise as it is a relatively small summit but sharp. In this case, the main criteria is discomfort to passengers, hence the suitable curve is transition curve on either side of the hump with a level strip in between.

**67. Ans: (d)**

**68. Ans: (a)**

**69. Ans: (a)**

**70. Ans: (b)**

**71. Ans: (d)**

**Sol:** Penetration test is applied exclusively to bitumen. As road tars are soft, penetration test cannot be used on tars.

Penetration value is affected by pouring temperature, size of needle, weight placed on needle, test temperature etc

**72. Ans: (d)**

**Sol:** GP is good for developing city.

GP promotes exponential growth, constant growth is promoted by arithmetic method.

**73. Ans: (a)**

**74. Ans: (a)**

**75. Ans: (a)**

**So:** Stiffness is more at the centre of the flexible footing in cohesion-less soils.

$\therefore$ Settlements depends on modulus of rigidity in flexible footing.

ACE Engineering Academy
Since 1995

# ACE
## Engineering Academy
Leading Institute for ESE/GATE/PSUs

23 Years of Excellence

# CONGRATULATIONS TO OUR
# ESE - 2018 TOP RANKERS

AIR 1 —  SHASHANK E&T

AIR 1 —  CHIRAG JHA EE

AIR 1 —  VINAY PRAKASH CE

AIR 1 —  AMAN JAIN ME

AIR 2 —  CHERUKURI SAIDEEP E&T

AIR 2 —  SHADAB AHAMAD EE

AIR 2 —  PUNIT SINGH CE

AIR 2 —  CHIRAG SINGLA ME

AIR 3 —  RAMESH KAMULLA E&T

AIR 3 —  SRIJAN VARMA EE

AIR 3 —  PRAVEEN KUMAR CE

AIR 3 —  MAYUR PATIL ME

AIR 4 —  JAPJIT SINGH E&T

AIR 4 —  ANKIT GARG EE

AIR 4 —  AMIT KUMAR ME

AIR 5 —  NARENDRA KUMAR E&T

AIR 5 —  KARTHIK KOTTURU EE

AIR 5 —  RISHABH DUTT CE

AIR 5 —  VITTHAL PANDEY ME

AIR 6 —  KUMUD JINDAL E&T

AIR 6 —  RATIPALLI NAGESWAR EE

AIR 7 —  KARTIKEYA DUTTA E&T

AIR 7 —  TEKCHAND DESHWAL EE

AIR 7 —  ROHIT KUMAR CE

AIR 8 —  SURYASH GAUTAM E&T

AIR 8 —  RAVI TEJA MANNE EE

AIR 8 —  VIJAYA NANDAN CE

AIR 8 —  ROHIT BANSAL ME

AIR 9 —  SHANAVAS CP E&T

AIR 9 —  SOUVIK DEB ROY EE

AIR 9 —  ROOPESH MITTAL CE

AIR 10 —  PRATHAMESH E&T

AIR 10 —  MILAN KRISHNA EE

AIR 10 —  SRICHAND POONIYA CE

| TOTAL SELECTIONS in Top 10 | 34 |
|---|---|

| | TOP 10 |
|---|---|
| E&T | 10 |
| EE | 10 |
| CE | 8 |
| ME | 6 |

and many more...

www.aceenggacademy.com