(7 pages) **Reg. No. :** .....

Code No. : 20065 E **Sub. Code : SMMA 53/ AMMA 53**

B.Sc. (CBCS) DEGREE EXAMINATION, NOVEMBER 2022.

Fifth Semester

Mathematics – Core

STATICS

(For those who joined in July 2017 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. If the angle between two equal forces P and P is α, then their resultant is ————————

(a) $2P$

(b) $2P\cos\alpha$

(c) $2P\cos\frac{\alpha}{2}$

(d) 0

2. If the resultant of two forces P and Q is at right angle to P, the angle between the forces is ————

(a) $\cos^{-1}(PQ)$ (b) $\cos^{-1}\left(\frac{P}{Q}\right)$

(c) $\cos^{-1}(-PQ)$ (d) $\cos^{-1}\left(-\frac{P}{Q}\right)$

3. Two paraller forces acting in the same direction are called ———————— forces.

(a) Like (b) Unlike

(c) Direct (d) Opposite

4. The magnitude of the resultant of two unlike parallel forces is their ————————

(a) difference (b) Sum

(c) multiplication (d) ratio

5. If three coplanar forces acting on a rigid body keep it in equilibrium, then they must be ————————

(a) concurrent (b) parallel

(c) either (a) or (b) (d) zero

6. The coefficient of friction μ =

(a) $\frac{F}{R}$ (b) FR

(c) $\tan^{-1}\left(\frac{F}{R}\right)$ (d) $\tan^{-1}(FR)$

7. The relation between the coefficient of friction and the angle of friction is ————————

(a) $\tan \mu = \lambda$ (b) $\tan \lambda = \mu$

(c) $\tan (\lambda \mu) = 1$ (d) $\tan \lambda = \frac{1}{\mu}$

8. The angle of repose of a rough inclined plane = ————————

(a) 0 (b) μ

(c) λ (d) $\tan^{-1} \lambda$

9. The intrinsic equation of the catenary is ————————

(a) $s = c \tan \psi$

(b) $s = \tan \psi$

(c) $s = c \tan\left(\frac{x}{c}\right)$

(d) $s = \tan h\left(\frac{x}{c}\right)$

10. If the weight per unit length of the chain is constant, then the caternary is called the ———— catenary.

(a) constant (b) same

(c) common (d) unique

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) State and prove the triangle law of forces.

Or

(b) Two forces act on a particle. If the sum and difference of the forces are at right angles to each other, show that the forces are of equal magnitude.

12. (a) Derive the condition of equilibrium of three coplanar paraller forces.

Or

(b) Three like parallel forces, acting at the vertices of a triangle, have magnitudes proportional to the opposite sides. Show that their resultant passes through the incentre of the triangle.

13. (a) State the procedure to be followed in solving any statical problem.

Or

(b) A heavy uniform rod of length 2a rests partly within and partly without a smooth hemispherical bowl of radius r, fixed with its rim horizontal. If α is the inclination of the rod to the horizon, show that $2r \cos 2\alpha = a \cos \alpha$.

14. (a) State the laws of friction.

Or

(b) Write a short note on:

(i) Angle of friction

(ii) Cone of friction

15. (a) Derive the cartesian equation of a catenary.

Or

(b) State and prove any one geometrical property of a common catenary.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) State and prove Lami's theorem.

Or

(b) If 0 is the circumcentre of the triangle ABC and the forces P,Q,R acting along the lines OA, OB, OC respectively are in equilibrium, then prove that

$$P:Q:R = a^2\left(b^2+c^2-a^2\right): b^2\left(a^2+c^2-b^2\right): c^2\left(a^2+b^2-c^2\right).$$

17. (a) Force P,Q, R act along the sides BC, AC, BA respectively of an equilateral triangle. If their resultant is a force parallel to BC through the centroid of the triangle, prove that $Q = R = \frac{P}{2}$.

Or

(b) State and prove Varigon's theorem.

18. (a) State and prove two Trigonometical theorems.

Or

(b) A heavy uniform sphere rests touching two smooth inclined planes one of which is inclined at 60° to the horizontal. If the pressure on this plane is one – half of the weight of the sphere, prove that the inclination of the other plane to the horizontal is 30°.

19. (a) A ladder 20 meters long with its centre of gravity 8 meters up from the bottom, weights 60 kg and rests at an angle of θ to the ground against a smooth vertical wall. The coefficient of friction between the ladder and the ground is $\frac{1}{2}$. Find the least value of θ which will enable a weighing 140 kg to reach the top with out the ladder slipping.

Or

(b) A body is at rest on a rough inclined plane and is acted upon by a force parallel to the plane. Find the limits between which the force must lie.

20. (a) Find the tension at any point of the catenary.

Or

(b) Explain the parabolic catenary.
