

028/2016

Maximum : 100 marks

Time : 1 hour and 15 minutes

1. A triangle lamina having a base 1 m and height 1.5 m is placed vertically under water with the base parallel to the water surface and the base below 3 m of water. The total force exerted on one face is :
- (A) 18.394 kN (B) 18.394 kg  
(C) 36.788 kN (D) 15.234 kg
2. If the velocity potential function is given by  $\phi = 3x - 4y$ , find the magnitude and direction of velocity at any point :
- (A) 4.87 m/s,  $45^\circ$  (B) 5 m/s,  $38^\circ 3'$   
(C) 5 m/s,  $53^\circ 7'$  (D) 7 m/s,  $61^\circ 7'$
3. A jet of water 40 mm in diameter has a velocity of 25 m/s. Find the power of the jet :
- (A) 10.81 kW (B) 9.82 kW  
(C) 10 kW (D) 4.35 kW
4. Find the bed slope 'i' of a wide rectangular channel so that the flow to reach a given critical depth  $d_c$  and Manning's coefficient  $n$  :
- (A)  $i = \frac{gn^3}{d_c^{2/3}}$  (B)  $i = \frac{gn^2}{d_c^{2/3}}$   
(C)  $i = \frac{gn}{d_c^{1/3}}$  (D)  $i = \frac{gn^2}{d_c^{1/3}}$
5. The discharge available from a tube well is 120 m<sup>3</sup>/hr. Assuming 3200 h of working of the tube well for a year, the intensity of irrigation as 50% and average depth of Rabi and Kharif crop as 48 cm, the culturable area that this tube well can command is :
- (A) 160 ha (B) 172 ha  
(C) 168 ha (D) 80 ha
6. Lacey's formula for fixation of water way is :
- (A)  $V = 0.55 y^{0.64}$  (B)  $4.75 \sqrt{Q}$   
(C)  $Q = Kai$  (D)  $Q = AV$

7. An offset is laid out  $2^\circ$  from its true direction on the field. If the scale of plotting is 10 m to 1 cm, find the maximum length of the offset so that the displacement of the point on the paper may not exceed 0.25 mm?
- (A) 5.0 m (B) 6.12 m  
(C) 7.16 m (D) 8.16 m
8. The following perpendicular offsets were taken at 10 m intervals from a survey line to an irregular boundary line :  
3.25, 5.6, 4.2, 6.65, 8.75, 6.2, 3.25, 4.2, 5.65. Calculate the area by trapezoidal rule
- (A) 433 m<sup>2</sup> (B) 439.67 m<sup>2</sup>  
(C) 424.44 m<sup>2</sup> (D) 440 m<sup>2</sup>
9. A square footing 2.5 m  $\times$  2.5 m is built in a homogeneous bed of sand of unit weight 20 kN/m<sup>3</sup> and having an angle of shearing resistance of  $36^\circ$ . The depth of the base of the footing is 1.5 m below the ground surface. Calculate the safe load that can be carried by a footing with a factor of safety 3 against complete shear failure?  
Bearing capacity factors  $N_c = 65.4$ ,  $N_q = 49.4$  and  $N_r = 54.0$
- (A) 4325 kN (B) 4927.5 kN  
(C) 5319.6 kN (D) 5462.5 kN
10. Hydrophobic cement is obtained by grinding ordinary Portland cement clinker with :
- (A) Hydrochloric acid (B) Oleic acid  
(C) Glycerine (D) Acetol
11. How much initial slump is required for a concrete mix to be fluidised by plasticizers or super plasticizers?
- (A) 2 to 3 cm (B) 2 to 3 mm  
(C) 5 cm (D) 10 mm
12. ISO: 800-2007 limits the values of width- thickness ratios of the elements of a steel section to place a check on :
- (A) Bending buckling (B) Torsional buckling  
(C) Flexural torsional buckling (D) Local buckling
13. The shape factor of a square of side 'a' with its diagonal parallel to the ZZZ axis is :
- (A) 2 (B) 1.7  
(C) 2.343 (D)  $2\sqrt{2}$

14. Strength of a 20 mm diameter bolt of grade 4.6 for a single cover butt joint. The cover plate being 10 mm thick. Assume steel of grade Fe 410,  $f_u = 410$  MPa, for bolts of grade 4.6,  $f_{ub} = 400$  MPa, Partial safety factor for the material of the bolt  $\gamma_{mb} = 1.25$  and net tensile stress area of 20 mm diameter bolt  $A_{nb} = 245$  mm<sup>2</sup>,  $k_b = 0.5$  in single shear is :
- (A) 80 kN (B) 45.26 kN  
(C) 96.0 kN (D) 125 kN
15. Minimum grade of concrete mix used for water retaining structures with alternate wetting and drying :
- (A) M 20 (B) M 25  
(C) M 30 (D) M 35
16. A hook 12 mm diameter is embedded in concrete for a distance of 100 mm. Calculate the maximum load which the hook can carry if the bond stress is not to exceed 1.28 N/mm<sup>2</sup> :
- (A) 5100 N (B) 415 N  
(C) 4825 N (D) 5000 N
17. Year's purchase for an old building if its future life is 15 years and the rate of interest is 7% on capital and 4% for sinking fund :
- (A) 8.333 (B) 9.231  
(C) 10.11 (D) 10.21
18. A beam of span  $l$  carries a concentrated load  $P$  at mid span. Work done by the external load is :
- (A)  $\frac{P^2 l^3}{48 EI}$  (B)  $\frac{P^2 l^3}{96 EI}$   
(C)  $\frac{Pl^3}{96 EI}$  (D)  $\frac{Pl^3}{48 EI}$
19. A three hinged arch of span 20 m and rise 4 m carries a uniformly distributed load of 25 kN/m. Horizontal thrust is :
- (A) 250 kN (B) 500 kN  
(C) 312.5 kN (D) 425 kN
20. Find the shortest length  $L$  for a pin ended steel column having a cross section of 60 mm × 100 mm for which Euler's formula applies. Take  $E_s = 2 \times 10^5$  N/mm<sup>2</sup> and critical proportional limit is 250 N/mm<sup>2</sup> :
- (A) 6000 mm (B) 2500 mm  
(C) 2000 mm (D) 1539 mm

21. Which method of analysis of water distribution system is most suitable for long and narrow pipe system?
- (A) Circle method (B) Hardy Cross Method  
(C) Equivalent Pipe method (D) Electrical Analysis method
22. For disinfecting water supply, it is required to treat 5,00,000 litres of daily supply with 0.5 ppm of chlorine. If the disinfectant is available in the form of bleaching powder containing 30% of available chlorine, the amount of bleaching powder required to treat the daily flow of water is :
- (A) 0.833 kg (B) 0.916 kg  
(C) 0.918 kg (D) None
23. In water treatment settling unit, water having a temperature of 20 Degree Centigrade carries solid particles with average diameter of 0.05 mm and specific gravity 1.20. Given  $\gamma = 1.01$  centi stokes. Settling velocity of settling particles is :
- (A) 0.027 cm/s (B) 3.1 mm/s  
(C) 2.73 cm/s (D) 0.21 mm/s
24. A main sewer is to be designed to receive a flow from 1 km<sup>2</sup> area of a community where the population density is 200 persons/ha. The average sewage flow is 150 litres per capita per day. Assume peak factor = 3. The design flow for the main sewer is :
- (A) 7.934 mlpd (B) 8.13 mlpd  
(C) 10.0 mlpd (D) 9.0 mlpd
25. At shut off head of a centrifugal pump, the discharge is :
- (A) Maximum (B) Zero  
(C) Rated Discharge (D) None
26. The minimum dissolved oxygen which should always be present in water in order to save aquatic life is :
- (A) 1 ppm (B) 40 ppm  
(C) 4 ppm (D) 10 ppm
27. In the case of surface water with a pH range of 6 to 8, which is the most suitable coagulant :
- (A) Alum (B) Quick lime  
(C) Lime (D) Potassium Permanganate
28. The pipe joint commonly used in pumping station are :
- (A) Flexible joint (B) Expansion joint  
(C) Flanged joint (D) Socket and spigot joint

29. The strength of chlorine in fresh bleaching powder is :
- (A) About 60% (B) About 10%  
(C) About 20% (D) About 30%
30. Estimated the quantity of secondary sludge produced by a secondary settling tank treating sewage discharge of 3.5 mld. The sludge may be assumed to have a solid concentration of 200 mg/l, removal efficiency of suspended solids as 90% and the solid content of the sludge as 6 per cent :
- (A) 10.5 cum/day  
(B) 8.3 cum/day  
(C) 9.1 cum/day  
(D) 7.93 cum/day
31. The equation used for experimental measurement of viscosity is :
- (A) Darcy equation (B) Stokes equation  
(C) Fanning equation (D) Hagen Poiseuille equation
32. Bernoullis equation is derived starting from :
- (A) Mass Balance (B) Force Balance  
(C) Momentum Balance (D) Energy Balance
33. Orificemeter is used for measuring :
- (A) Pressure (B) Flow rate  
(C) Density (D) Viscosity
34. Optical Pyrometer working principle is based on :
- (A) Stefan-Boltzmann law (B) Weins displacement law  
(C) Kirchoff law (D) Plancks law
35. Froude number is directly proportional to :
- (A) Impeller speed (B) Fluid viscosity  
(C) Square of Impeller diameter (D) Square of impeller speed
36. Centrifuging in Ball mills occur when the speed is :
- (A) Equal to Critical speed (B) Less than critical speed  
(C) Greater than critical speed (D) None of the above
37. Peclet Number  $NP_e$  is the product of :
- (A) Reynolds Number and Nusselt Number  
(B) Reynolds No. and Prandtl No.  
(C) Prandtl No. and Nusselt No.  
(D) Reynolds No. and Rayleigh No.

38. LMTD correction factors are used for :
- (A) Parallel flow (B) Counter Flow  
(C) Cross flow (D) All the above three
39. Slugging in fluidized beds occur when :
- (A) Particles are large and heavy  
(B) The Vessel is narrow and the bed is deep  
(C) Neither (A) nor (B)  
(D) Both (A) and (B)
40. Michaelis - Menten parameters can be evaluated using :
- (A) Eadie Hofstee Plot (B) Lineweaver Burke Plot  
(C) Neither (A) nor (B) (D) Both (A) and (B)
41. In the CGS system 1 stoke is defined as :
- (A)  $1 \text{ ft}^2 / \text{s}$  (B)  $1 \text{ m}^2 / \text{s}$   
(C)  $1 \text{ in}^2 / \text{s}$  (D)  $1 \text{ cm}^2 / \text{s}$
42. Boiling Point Elevation of solutions strongly influences :
- (A) Capacity of multiple effect evaporators  
(B) Economy of multiple effect evaporators  
(C) Both capacity and economy  
(D) Neither capacity nor economy
43. At all humidities other than zero or hundred percentage, percentage humidity is :
- (A) Greater than relative humidity (B) Equal to relative humidity  
(C) Less than relative humidity (D) None of the above
44. Many important fermentation products like antibiotics are formed during :
- (A) Lag phase (B) Growth phase  
(C) Stationary phase (D) Death phase of cell growth
45. Dilution rate D for a bioreactor is the reciprocal of :
- (A) Space Time (B) Residence Time  
(C) Space velocity (D) Time constant
46. Ficks law of diffusion is analogous to :
- (A) Newtons law of viscosity (B) Fouriers law of heat conduction  
(C) Both (A) and (B) (D) Neither (A) nor (B)

47. Temperature dependency of equilibrium constant is predicted by :  
(A) Vant Hoff Equation (B) Clayperon Equation  
(C) Raoult's law (D) Arrhenius Equation
48. In an ideal PFR, the reactant concentration :  
(A) is uniform within the reactor  
(B) varies along the cross section of the reactor  
(C) varies along the length of the reactor  
(D) none of the above
49. Baffles in shell and Tube heat exchangers are provided mainly for :  
(A) Increasing shell side turbulence (B) Increasing tube side turbulence  
(C) Fixing the tubes (D) Fixing the tie rods
50. Conversions in reversible exothermic reactions can be improved by :  
(A) Interstage Heating (B) Interstage Cooling  
(C) Isothermal Operation (D) Isobaric operations
51. Frossling correlation relates mass transfer coefficient with :  
(A) Particle size (B) Particle velocity  
(C) Mass diffusivity (D) All the above three
52. Knudsen diffusivity is :  
(A) Directly proportional to pressure  
(B) Independant of pressure  
(C) Proportional to square root of pressure  
(D) Inversely proportional to pressure
53. Crushing Rolls are :  
(A) Primary crushers (B) Grinders  
(C) Ultrafine grinders (D) None of the above
54. Differential method of analysis of kinetic data is :  
(A) Complex but accurate (B) Simple and accurate  
(C) Complex and inaccurate (D) Simple and inaccurate
55. Rate Selectivity parameter is important in the design of :  
(A) Multiple reactions (B) Single reactions  
(C) Elementary reactions (D) None of the above