

# UPPSC-AE 2021

UTTAR PRADESH PUBLIC SERVICE COMMISSION

Combined State Engineering  
Services Examination

**Assistant Engineer**

## Mechanical Engineering

Previous Years Solved Papers

Objective Papers

General Hindi

General Studies

Practice Questions



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**UPPSC-AE 2021 : Mechanical Engineering Previous Solved Papers**

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# Preface

**UPPSC Assistant Engineer Examination** has been always preferred by Engineers due to job stability and opportunity to work in home state. UPPSC Combined State Engineering Services examination is conducted time to time but not every year. MADE EASY team has made deep study of previous exam papers and observed that a good percentage of questions are of repetitive in nature, therefore previous year's papers are advisable to solve before a candidate takes the exam. This book is also useful for MP State Engineering Services, UPSC Engineering Services and other Competitive exams for Engineering graduates.



**B. Singh** (Ex. IES)

The current edition of this book contains complete solutions to all questions with accuracy. I have true desire to serve student community by providing good source of study and quality guidance. I hope this book will be proved an important tool to succeed in UPPSC and other competitive exams. Any suggestions from the readers for improvement of this book are most welcome.

With Best Wishes

**B. Singh**

CMD, MADE EASY

# UPPSC : Exam Pattern

## Combined State Engineering Services Examination 2019 Assistant Engineer examination

<b>Paper I : Objective</b> <b>Maximum Time : 2½ Hours • Maximum Marks : 375</b> Each question carries 3 marks. There is a penalty of –1 mark for every wrong attempted answer	
General Hindi	25 Questions
Technical Paper I	100 Questions
<b>Total</b>	<b>125 Questions (375 Marks)</b>

<b>Paper II : Objective</b> <b>Maximum Time : 2½ Hours • Maximum Marks : 375</b> Each question carries 3 marks. There is a penalty of –1 mark for every wrong attempted answer	
General Studies	25 Questions
Technical Paper II	100 Questions
<b>Total</b>	<b>125 Questions (375 Marks)</b>

# Uttar Pradesh Public Service Commission

## Combined State Engineering Services Examination

### Assistant Engineer

## Mechanical Engineering

### Paper-I

#### **Engineering Mechanics:**

Analysis of force systems, friction, centroid and centre of gravity, trusses and beams, principle of virtual work, kinematics and kinetics of particle, kinematics and kinetics of rigid bodies.

#### **Mechanism and Machines:**

Velocity and acceleration of links, cams and followers gears and gear trains clutches, belt drives, brakes and dynamometers, Flywheel and governors, balancing of rotating and reciprocating masses, balancing of multi cylinder engines, Free and forced vibration, damped vibration, whirling of shafts.

#### **Mechanics of Solids:**

Stresses and strains, compound stresses strains, Torsion of circular shafts, stresses and deflections in beams unsymmetrical bending, curved beams, Thin and thick cylinders and spheres, Buckling of columns, Energy methods, helical and leaf springs.

#### **Design of Machine Elements:**

Design for Static and dynamic loading, Theories of failure, fatigue principles of design of riveted, welded and bolted joints, shafts, springs, bearings, brakes, clutches and flywheels.

#### **Engineering Materials:**

Crystal systems and crystallography, crystal imperfections, Alloys and phase diagrams, Heat treatment, ferrous and non ferrous metals and alloys, Mechanical properties and testing.

#### **Manufacturing:**

Metal casting, metal forming, metal joining, Mechanics of metal cutting, machining and machine tool operations, unconventional machining methods limits, fits and tolerances, inspection: Surface roughness, comparators, computer integrated manufacturing, Flexible manufacturing systems, jigs and fixtures.

#### **Industrial Engineering:**

Production, planning and control, inventory control and operation, research, CPM and PERT.

#### **Mechatronics and Robotics:**

Microprocessors and microcontrollers, Architecture, Programming, Computer interfacing Programmable logic controller, sensors and actuators, Piezoelectric accelerometers, Hall effect sensors, optical encoder, resolver, Inductosyn, Pneumatic and Hydraulic Actuators, stepper motor, control system, mathematical modeling, control signals, controllability and observability, Robotics: Robot classification, robot specification. Notation: Direct and inverse kinematics homogeneous co-ordinates and arm equation of four axis SCARA Robot.

### Paper-II

#### **Thermodynamics:**

Thermodynamic systems and processes, properties of pure substances, concepts and applications of zeroth, first and second law of thermodynamics, entropy, availability and irreversibility, detailed analysis of thermodynamic cycles, ideal and real gases, fuels and combustion.

#### **Fluid Mechanics :**

Basic concepts and properties of fluids, manometry, fluid statics, buoyancy, equations of motion, Bernoulli's equation and applications, viscous flow of incompressible fluids, laminar and turbulent flows, flow through pipes and head losses in pipes, dimensional analysis, Forces on immersed bodies and boundary layer over a flat plate, isentropic and adiabatic flows, normal shock waves.

#### **Heat Transfer:**

Modes of heat transfer, steady and unsteady heat conduction, thermocouple time constant, critical thickness of insulation, heat transfer from fins, momentum and energy equations for boundary layer flow on a flat plate. Free and forced convection, radiation heat transfer, Stefan-Boltzmann law, shape factor, black and grey body radiation heat exchange, boiling and condensation, heat exchanger analysis, LMTD and NTU – effectiveness methods.

#### **Energy conversion:**

SI and CI engines, performance characteristics and testing of IC engines, combustion phenomena in SI and CI engines, carburetion and fuel injection systems, emissions and emission control. Reciprocating and rotary pumps, pelton wheel, Francis and Kaplan turbines, velocity diagrams impulse and reaction principles steam and gas turbines; Rankine and Brayton cycles with regeneration and reheat, high pressure boilers, draft, condensers. Unconventional power systems, including nuclear, MHD, biomass, wind and tidal systems, utilization of solar energy; Reciprocating and rotary compressors; theory and applications, Theory of propulsions, pulse jet and ramjet engines.

#### **Environmental control:**

Vapour compression, vapour absorption, steam jet and air refrigeration systems, properties of refrigerant and their nomenclature, psychometrics properties and processes, psychrometric relations, use of psychrometric chart, load estimation, supply air conditions, sensible heat factors, air conditioning system layout, comfort chart, comfort and industrial air conditioning.

■■■■

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# **UPPSC-AE**

Combined State Engineering  
Services Examination

## **Section-A**

# **Mechanical Engineering**



**Objective Practice Questions**

# UPPSC-AE Paper-I : 2019

## Mechanical Engineering

**Q.1** Material handling and plant location is analysed by  
 (a) Gantt Chart (b) Bin Chart  
 (c) Travel Chart (d) Emerson Chart

**Q.2** In PERT and CPM network the dummy activity  
 (a) Consumes time  
 (b) Consume resources  
 (c) Is used to preserve the logic  
 (d) Is a real activity

**Q.3** The following measurement are carried out by internal state sensors of the end effector  
 (a) Position  
 (b) Position and Velocity  
 (c) Velocity and Acceleration  
 (d) Position, Velocity and Acceleration

**Q.4** In a microprocessor, RISC stands for  
 (a) Restructured Instruction Set Computer  
 (b) Redefined Instruction Set Computer  
 (c) Reduced Instruction Set Computer  
 (d) Regional Instruction Set Computer

**Q.5** Which of the following provides anticlockwise and clockwise rotation about the vertical axis perpendicular to the arm?  
 (a) Shoulder swivel (b) Arm sweep  
 (c) Wrist bend (d) Elbow extension

**Q.6** PLC operates on following signals  
 (a) Digital (b) Impulse  
 (c) Analog (d) Frequency

**Q.7** A disc of radius 30 cm is rolling without slip with angular velocity of 10 rad/s on a horizontal surface. Which of the following statements is NOT true?  
 (a) Linear velocity of all the points is different  
 (b) Speed of all the points is different  
 (c) Acceleration of all the points is different  
 (d) Linear velocity of the point touching the horizontal surface is zero.

**Q.8** The ratio of magnitude of linear momentum for two objects having mass 30 kg and 10 kg respectively with equal kinetic energy is

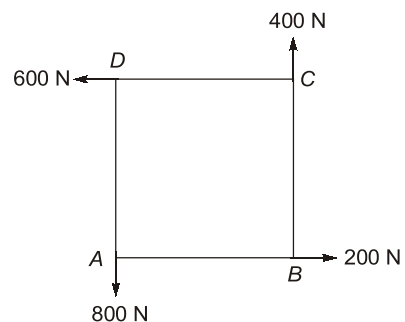
- (a)  $\sqrt{\frac{1}{3}}$  (b)  $(3)^2$   
 (c)  $\sqrt{3}$  (d)  $\left(\frac{1}{\sqrt{3}}\right)^2$

**Q.9** Condition for stable equilibrium of a conservative force system in terms of potential energy  $U$  is  
 (a)  $\delta U = 0$  and  $\delta^2 U = 0$   
 (b)  $\delta U = 0$  and  $\delta^2 U > 0$   
 (c)  $\delta U = 0$  and  $\delta^2 U < 0$   
 (d)  $\delta U > 0$  and  $\delta^2 U = 0$

**Q.10** A simply supported beam of length  $l$ , carries a load  $w(x) = w_0 x$  over the entire span. Maximum bending moment in the beam at  $x$  will be

- (a)  $\frac{l}{3}$  (b)  $\frac{l}{\sqrt{3}}$   
 (c)  $\frac{l\sqrt{3}}{2}$  (d)  $\frac{l}{\sqrt{2}}$

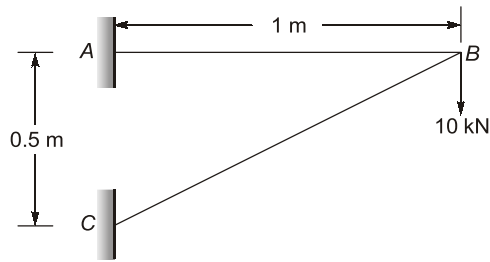
**Q.11** Four forces having magnitudes of 200 N, 400 N, 600 N and 800 N respectively acting along four sides (1 m each) of a square ABCD as shown in figure. Determine the magnitude of direction of the resultant force from A along the line AB.



- (a)  $400\sqrt{3}$  N, 3.2 m from A  
 (b)  $400\sqrt{2}$  N, 2.5 m from A  
 (c)  $300\sqrt{2}$  N, 2 m from A  
 (d)  $300\sqrt{3}$  N, 2.5 m from A



**Q.12** A two member truss ABC is shown in figure. The axial force (in kN) transmitted in member AB is



- (a) 40 kN                      (b) 10 kN  
(c) 20 kN                      (d) 30 kN

**Q.13** If the propeller of an aeroplane rotates clockwise when viewed from the rear and the aeroplane takes a right turn, the gyroscopic effect will

- (a) Tend to raise the tail and depress the nose  
(b) Tend to raise the nose and depress the tail  
(c) Tilt the aeroplane about spin axis  
(d) Have no effect

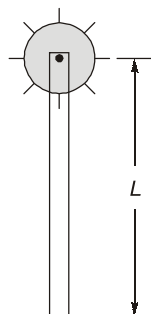
**Q.14** A man is climbing up a ladder which is resting against a vertical wall. When he was exactly half way up, the ladder started slipping. The path traced by the man is

- (a) Parabola                      (b) Circle  
(c) Ellipse                      (d) Hyperbola

**Q.15** When the primary direct crank of a reciprocating engine positioned at  $30^\circ$  clockwise, the secondary reverse crank for balancing will be at

- (a)  $30^\circ$  anticlockwise  
(b)  $60^\circ$  anticlockwise  
(c)  $30^\circ$  clockwise  
(d)  $60^\circ$  clockwise

**Q.16** A thin uniform rod of length  $L$  and mass  $M$  is free to rotate in vertical plane as shown in figure below. The time period of its oscillation in vertical plane is



(a)  $T = 2\pi\sqrt{\frac{L}{2g}}$                       (b)  $T = 2\pi\sqrt{\frac{2L}{3g}}$

(c)  $T = 2\pi\sqrt{\frac{L}{g}}$                       (d)  $T = 2\pi\sqrt{\frac{3L}{4g}}$

**Q.17** A 60 kg man is weighed by a balance as 54 kg in lift which is accelerated downwards. The acceleration of the lift is

- (a)  $1.26 \text{ m/s}^2$                       (b)  $1.98 \text{ m/s}^2$   
(c)  $0.98 \text{ m/s}^2$                       (d)  $1.76 \text{ m/s}^2$

**Q.18** Smallest and largest natural frequency of a 'n' degree freedom system are  $\omega_1$  and  $\omega_n$  respectively. Approximate natural frequency estimated by Rayleigh's and Dunkerley's methods are  $\omega_r$  and  $\omega_d$  respectively. Which of the following statements is true?

- (a)  $\omega_r < \omega_1$  and  $\omega_d < \omega_1$   
(b)  $\omega_r < \omega_1$  and  $\omega_d > \omega_1$   
(c)  $\omega_r > \omega_1$  and  $\omega_d > \omega_1$   
(d)  $\omega_r > \omega_1$  and  $\omega_d < \omega_1$

**Q.19** A thin spherical shell is subjected to an external pressure  $p_0$ . The volumetric strain of the spherical shell is (where,  $d$  is the diameter of shell,  $t$  is the thickness of the shell,  $E$  is Young's modulus of elasticity of shell material,  $\mu$  is Poisson's ratio of shell material)

- (a)  $\frac{p_0 d}{4tE}(5 - 4\mu)$                       (b)  $\frac{3p_0 d}{4tE}(1 - \mu)$   
(c)  $\frac{3p_0 d}{4tE}(1 - 2\mu)$                       (d)  $\frac{-3p_0 d}{4tE}(1 - \mu)$

**Q.20** When there is a sudden increase or decrease in shear force diagram between any two points, it indicates that there is

- (a) No loading between the two points  
(b) Point load at the two points  
(c) Uniformly varying load between the two points  
(d) Uniformly distributed load between the two points

**Q.21** Maximum shear stress in a solid shaft of diameter  $D$  and Length  $L$  twisted through an angle  $\theta$  is  $\tau$ . A hollow shaft of the same material and length having outside and inside diameters of  $D$  and  $\frac{D}{2}$  respectively is also twisted through the same

angle of twist  $\theta$ . The value of maximum shear stress in the hollow shaft will be

- (a)  $\frac{16}{15}\tau$  (b)  $\frac{8}{7}\tau$   
(c)  $\frac{4}{3}\tau$  (d)  $\tau$

**Q.22** A spring used to absorb shocks and vibrations is  
(a) Torsion spring (b) Conical spring  
(c) Leaf spring (d) Disc spring

**Q.23** Two shafts of equal length and similar material in which one is hollow and other is solid are transmitting same level of torque. If the inside diameter is  $\frac{2}{3}$  of the outside diameter of the hollow shaft, the ratio of weight of hollow shaft to weight of solid shaft is  
(a) 0.642 (b) 0.358  
(c) 0.732 (d) 1.444

**Q.24** For the state of stress of pure shear  $\tau$ , the strain energy stored per unit volume in the elastic, homogeneous, isotropic material having elastic constants-Young's modulus,  $E$  and Poisson's ratio  $\mu$  will be

- (a)  $\frac{\tau^2}{E}(1+\mu)$  (b)  $\frac{\tau^2}{2E}(1+\mu)$   
(c)  $\frac{2\tau^2}{E}(1+\mu)$  (d)  $\frac{2\tau^2}{2E}(2+\mu)$

**Q.25** A circular solid rod of diameter 'd' welded to a rigid flat plate by a circular fillet weld of throat thickness 't' is subjected to a twisting moment 'T'. The maximum shear stress induced in the weld is

- (a)  $\frac{T}{\pi t d^2}$  (b)  $\frac{2T}{\pi t d^2}$   
(c)  $\frac{4T}{\pi t d^2}$  (d)  $\frac{8T}{\pi t d^2}$

**Q.26** The notch sensitivity  $q$  is expressed in terms of fatigue stress concentration factor  $K_f$  and theoretical stress concentration factor  $K_t$  as

- (a)  $\frac{K_f + 1}{K_t + 1}$  (b)  $\frac{K_f - 1}{K_t - 1}$   
(c)  $\frac{K_t + 1}{K_f + 1}$  (d)  $\frac{K_t - 1}{K_f - 1}$

**Q.27** A shaft has dimension  $\phi 35$  ( $-0.009$  to  $-0.025$ ). The respective values of fundamental deviation and tolerance are

- (a)  $-0.025 \pm 0.008$  (b)  $-0.025, 0.016$   
(c)  $-0.009 \pm 0.008$  (d)  $-0.009, 0.016$

**Q.28** A thin walled spherical shell is subjected to an internal pressure. If the radius of the shell is increased by 1% and the thickness is reduced by 1% with the internal pressure remaining the same, the % change in circumferential (hoop) stress is

- (a) 0 (b) 1  
(c) 1.08 (d) 2.02

**Q.29** If there are  $n_1$  discs on the driving shaft and  $n_2$  discs on the driven shaft in a multiplate clutch, then the number of pairs of contact surface is

- (a)  $n_1 + n_2$  (b)  $n_1 + n_2 - 1$   
(c)  $n_1 + n_2 + 1$  (d)  $n_1 + n_2 + 2$

**Q.30** When a helical compression spring is cut into halves, the stiffness of the resulting spring will be

- (a) One half (b) One fourth  
(c) Double (d) Same

**Q.31** Chromium as an alloying element in alloy steel is used principally to

- (a) Improve harden ability  
(b) Improve mechanical properties at low temperature  
(c) Improve mechanical properties at elevated temperature  
(d) Improve the corrosion and oxidation resistance

**Q.32** The compositions of some of the alloy steels are as under

1. 18W4Cr1V      2. 12M<sub>0</sub>1W4Cr1V  
3. 5M<sub>0</sub>6W4Cr2V      4. 18W8Cr1V

The composition of commonly used high speed steels would include

- (a) 1 and 2 (b) 2 and 3  
(c) 1 and 4 (d) 1 and 3

**Q.33** The materials which show direction dependent properties are called

- (a) Homogeneous materials  
(b) Viscoelastic materials  
(c) Isotropic materials  
(d) Anisotropic materials

- Q.34** Atomic radius of Face Centered Cubic (FCC) crystal is  
 $a$  = Lattice parameter
- (a)  $\frac{a\sqrt{2}}{4}$  (b)  $\frac{a\sqrt{3}}{2}$   
(c)  $\frac{a\sqrt{3}}{4}$  (d)  $\frac{a\sqrt{2}}{3}$
- Q.35** Which of the following phase of steel is NOT present in iron-carbon phase diagram?  
(a) Ferrite (b) Cementite  
(c) Austenite (d) Martensite
- Q.36** The machine tool guide ways are usually hardened by  
(a) Induction hardening  
(b) Flame hardening  
(c) Vacuum hardening  
(d) Martempering
- Q.37** Twin boundaries are which type of crystal defect?  
(a) Line defect (b) Point defect  
(c) Surface defect (d) None of the above
- Q.38** The function of interpolator in a CNC machine controller is to  
(a) Control spindle speed  
(b) Control feed rate of axes  
(c) Control tool rapid speed  
(d) Perform miscellaneous (M) function
- Q.39** During calculation of material removal rate in electro-discharge machining, supply voltage was used 60 V. Condition for maximum power delivery to the discharge circuit is satisfied. The ratio of actual to calculated material removal rate will be  
(a)  $\frac{3}{2}$  (b)  $\frac{4}{9}$   
(c)  $\frac{9}{4}$  (d)  $\frac{2}{3}$
- Q.40** Straight polarity in arc welding is obtained with  
(a) Alternating current electrode with electrode being positive  
(b) Direct current electrode with electrode being positive  
(c) Direct current electrode with electrode being negative  
(d) Alternating current electrode with electrode being negative
- Q.41** A good machinability rating would indicate  
(a) Long tool life, high power requirement and less machining time  
(b) Long tool life, low power requirement and a good surface finish  
(c) Short tool life and a good surface finish  
(d) Long tool life, high power requirement and a good surface finish
- Q.42** Find the blanking force required to punch 10 mm diameter holes in a steel sheet of 3 mm thickness. Given shear strength of material = 400 MPa, penetration = 40% and shear provided on the punch = 2 mm.  
(a) 22.6 kN (b) 37.7 kN  
(c) 61.6 kN (d) 94.3 kN
- Q.43** If the speed of machining combined cemented carbide and steel tool is halved, then the tool life changes by (assume Taylor's exponent = 0.25 for single point turning operation)  
(a) 2 times (b) 4 times  
(c) 8 times (d) 16 times
- Q.44** In which of the following welding process flux is fed separately?  
(a) Electric arc welding  
(b) Plasma arc welding  
(c) Tungsten inert gas arc welding  
(d) Submerged arc welding
- Q.45** Which of the following operation does NOT use a jig?  
(a) Tapping (b) Reaming  
(c) Turning (d) Drilling
- Q.46** In machining operation if path of generatrix and directrix are circular and straight line respectively, the surface obtained will be  
(a) Cylindrical (b) Helical  
(c) Plain (d) Surface of revolution
- Q.47** Critical path method is good for  
(a) Small projects only  
(b) Large projects only  
(c) Both small and large projects equally  
(d) Neither small nor large projects

- Q.92** Low helix angle drills are used for drilling holes  
(a) Plastics (b) Copper  
(c) Cast steel (d) Carbon steel
- Q.93** In Ultrasonic Machining (USM) process the material removal rate will be higher for materials with  
(a) Higher ductility  
(b) Higher fracture strain  
(c) Lower toughness  
(d) Higher toughness
- Q.94** Which of the following represents the type of fit for a hole and shaft pair? Given that  
hole =  $50^{+0.04}_{+0.00}$  mm and shaft =  $50^{+0.060}_{+0.041}$  mm  
(a) Clearance fit (b) Loose fit  
(c) Transition fit (d) Interference fit
- Q.95** For machining ceramics, glasses and plastics, which method is NOT applicable?  
(a) LBM (b) AJM  
(c) EDM (d) USM
- Q.96** A comparator for its working depends on  
(a) Accurately calibrated scale  
(b) Comparison with standard such as slip gauges  
(c) Optical device  
(d) Limit gauges
- Q.97** In machining processes, the percentage of total heat generated in shear action is carried away by the chips to the extent of  
(a) 10% (b) 25%  
(c) 50% (d) 80%
- Q.98** Group Technology brings together and organises  
(a) Parts and simulation analysis  
(b) Documentation and analysis  
(c) Automation and tool production  
(d) Common parts, problems and tasks
- Q.99** Which of the following layout is used for the manufacturing of large aircrafts?  
(a) Product layout  
(b) Process layout  
(c) Fixed position layout  
(d) Combination layout
- Q.100** The leaving basic variable in simplex method is the basic variable that  
(a) has the lowest value  
(b) has the smallest coefficient in the key row  
(c) has the largest coefficient in the key row  
(d) goes to zero first, as the entering basic variable is increased


**Answers UPPSC-AE Paper-I : 2019**

- |         |         |         |          |         |         |         |         |
|---------|---------|---------|----------|---------|---------|---------|---------|
| 1. (c)  | 2. (c)  | 3. (d)  | 4. (c)   | 5. (b)  | 6. (a)  | 7. (b)  | 8. (c)  |
| 9. (b)  | 10. (b) | 11. (b) | 12. (c)  | 13. (a) | 14. (b) | 15. (b) | 16. (b) |
| 17. (c) | 18. (d) | 19. (d) | 20. (b)  | 21. (d) | 22. (c) | 23. (a) | 24. (a) |
| 25. (b) | 26. (b) | 27. (d) | 28. (d)  | 29. (b) | 30. (c) | 31. (d) | 32. (d) |
| 33. (d) | 34. (a) | 35. (d) | 36. (b)  | 37. (c) | 38. (b) | 39. (b) | 40. (c) |
| 41. (b) | 42. (a) | 43. (d) | 44. (d)  | 45. (c) | 46. (a) | 47. (c) | 48. (c) |
| 49. (c) | 50. (d) | 51. (c) | 52. (d)  | 53. (c) | 54. (c) | 55. (d) | 56. (b) |
| 57. (a) | 58. (d) | 59. (a) | 60. (b)  | 61. (b) | 62. (b) | 63. (d) | 64. (c) |
| 65. (b) | 66. (b) | 67. (b) | 68. (a)  | 69. (d) | 70. (d) | 71. (b) | 72. (d) |
| 73. (b) | 74. (c) | 75. (b) | 76. (c)  | 77. (c) | 78. (d) | 79. (d) | 80. (*) |
| 81. (d) | 82. (d) | 83. (d) | 84. (b)  | 85. (d) | 86. (a) | 87. (a) | 88. (c) |
| 89. (a) | 90. (c) | 91. (d) | 92. (d)  | 93. (c) | 94. (d) | 95. (c) | 96. (b) |
| 97. (d) | 98. (d) | 99. (c) | 100. (b) |         |         |         |         |

### Explanations

**1. (c)**

Travel chart is the chart which gives an estimate about the amount of materials handled between various work stations of a plant. Its aim is to decide such layout where overall material handling is performed at minimum cost. It is a table in which each column and row represents single work station.

**2. (c)**

Dummy activity neither consume time nor the resources and is not a real activity.

**3. (d)**

Internal sensors measures the robot's internal state. They are used to measure its position, velocity and acceleration.

**5. (b)**

The basic manipulator arm may have only three axes:

Arm sweep : It provides anti-clockwise and clockwise rotation about the vertical axis.

Shoulder swivel: It provides the arm to pitch up and down about a horizontal shoulder axis.

Elbow extension : It provides the arm to pitch up and down about a horizontal elbow axis.

**6. (a)**

A PLC or programmable logic controller is a specialized computer which is used to control machines and processes. It operates on digital signals.

**7. (b)**

For rolling without slip, speed of all points is same.

**8. (c)**

Given:  $m_1 = 30 \text{ kg}$ ,  $m_2 = 10 \text{ kg}$

Also, KE of object 1 and 2,  $KE_1 = KE_2$

$$\Rightarrow \frac{1}{2} m_1 V_1^2 = \frac{1}{2} m_2 V_2^2$$

$$\Rightarrow 30 V_1^2 = 10 V_2^2$$

$$\frac{V_1}{V_2} = \frac{1}{\sqrt{3}}$$

Ratio of linear momentum

$$= \frac{m_1 V_1}{m_2 V_2} = \frac{30}{10} \times \frac{1}{\sqrt{3}} = \sqrt{3}$$

Alternatively,

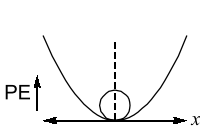
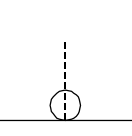
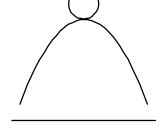
$$\text{Using, } KE = \frac{P^2}{2m}$$

$$KE_1 = KE_2$$

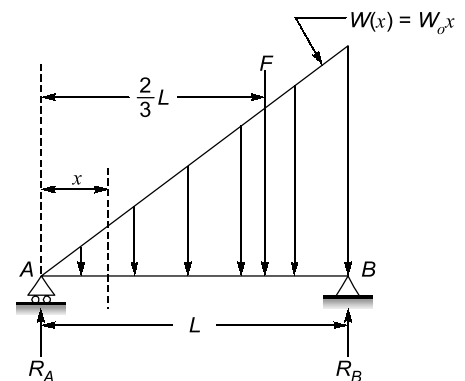
$$\frac{P_1^2}{2m_1} = \frac{P_2^2}{2m_2}$$

$$\frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{3}$$

**9. (b)**

		
Stable equilibrium	Neutral equilibrium	Unstable equilibrium
$\frac{du}{dx} = 0$ $\frac{d^2u}{dx^2} > 0$	$\frac{du}{dx} = 0$ $\frac{d^2u}{dx^2} = 0$	$\frac{du}{dx} = 0$ $\frac{d^2u}{dx^2} < 0$

**10. (b)**



$$F = \frac{1}{2} (W_o L) \times L = \frac{1}{2} W_o L^2$$

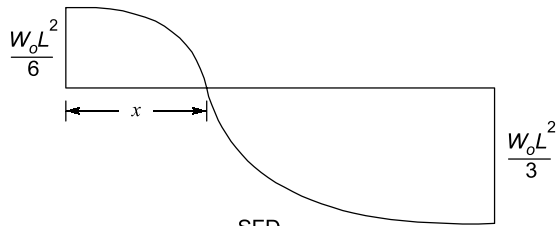
$$R_A + R_B = F \dots (i)$$

$$\Sigma M_B = 0$$

$$R_A \times L - F \times \frac{L}{3} = 0$$

$$R_A = \frac{F}{3} = \frac{W_o L^2}{6}$$

$$\text{From (i)} \quad R_B = \frac{W_o L^2}{3}$$



SFD

SF at cross-section X-X

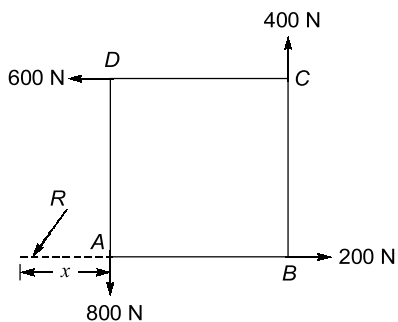
$$SF = R_A - \frac{1}{2}(W_o x) \times x$$

BM max where SF = 0

$$\Rightarrow R_A = \frac{1}{2}(W_o x^2)$$

$$\frac{W_o L^2}{6} = \frac{W_o x^2}{2}$$

$$x = \frac{L}{\sqrt{3}}$$

**11. (b)**

Resultant force (R)

$$\Sigma F_x = 400 \text{ N}$$

$$\Sigma F_y = 400 \text{ N}$$

$$R = \sqrt{400^2 + 400^2} = 400\sqrt{2} \text{ N}$$

Let resultant cut AB at x from A

 $\Sigma M_A$  = Moment of resultant about A

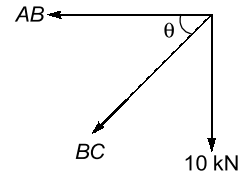
$$600 \times 1 + 400 \times 1 = R_V \times x$$

$$1000 = 400x$$

$$x = 2.5 \text{ m}$$

**12. (c)**

Consider forces at point B,



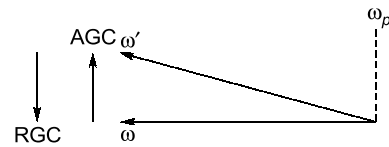
$$\tan \theta = \frac{0.5}{1} = 0.5$$

Using Lami's theorem,

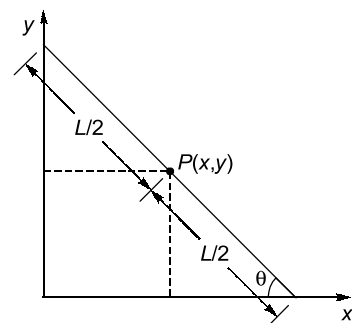
$$\frac{10}{\sin \theta} = \frac{AB}{\sin(90 - \theta)} = \frac{BC}{\sin 270^\circ}$$

$$\frac{10}{\sin \theta} = \frac{AB}{\cos \theta}$$

$$AB = \frac{10}{\tan \theta} = \frac{10}{0.5} = 20 \text{ kN}$$

**13. (a)**

As the reactive Gyroscopic couple direction is downward thus the tail will raise and nose depress.

**14. (b)**

$$x = \frac{L}{2} \cos \theta; y = \frac{L}{2} \sin \theta$$

$$x^2 + y^2 = \left(\frac{L}{2}\right)^2 \cos^2 \theta + \left(\frac{L}{2}\right)^2 \sin^2 \theta$$

$$x^2 + y^2 = \left(\frac{L}{2}\right)^2; \text{ equation of circle}$$

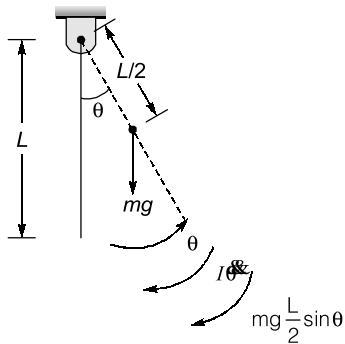
**15. (b)**

Primary force,  $F_p = m r \omega^2 \cos \theta$

Secondary force,  $F_s = m \omega^2 r \frac{\cos 2\theta}{n}$

It is given that the angle made by the crank is  $\theta = 30^\circ$  clockwise. To completely balance the secondary forces a reverse crank at angle  $2\theta$  is applied in anticlockwise direction.

Thus, the reverse crank is at  $60^\circ$  in the anticlockwise direction.

**16. (b)**

Disturb rod by small angle  $\theta$

$$I\ddot{\theta} + mg \frac{L}{2} \sin \theta = 0$$

[For small angle  $\sin \theta \approx \theta$ ]

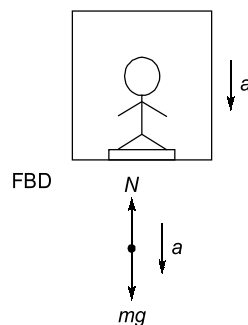
$$\Rightarrow I\ddot{\theta} + mg \frac{L}{2} \theta = 0$$

$$\frac{mL^2}{3} \ddot{\theta} + mg \frac{L}{2} \theta = 0 \left[ I = \frac{mL^2}{12} + \frac{mL^2}{4} = \frac{mL^2}{3} \right]$$

$$\ddot{\theta} + \frac{3g}{2L} \theta = 0$$

$$\omega_n = \sqrt{\frac{3g}{2L}}$$

$$T = \frac{2\pi}{\omega_n} = 2\pi \sqrt{\frac{2L}{3g}}$$

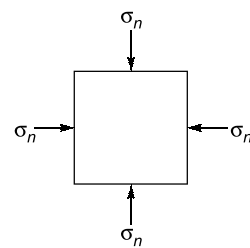
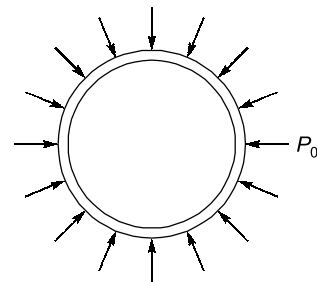
**17. (c)**

Weight measured by balance machine equal to normal reaction  $N = 54g$

$$mg - N = ma$$

$$60g - 54g = 60a$$

$$a = \frac{6g}{60} = \frac{6 \times 9.81}{60} = 0.981 \text{ m/s}^2$$

**19. (d)**

$$\sigma_n = \frac{P_0 D}{4t}$$

$$\epsilon_n = \frac{-\sigma_n}{E} + \mu \frac{\sigma_n}{E}$$

$$= \frac{-\sigma_n}{E} (1 - \mu)$$

$$= \frac{-P_0 D}{4tE} (1 - \mu)$$

Volumetric strain sphere,

$$\epsilon_v = 3\epsilon_n$$

$$= \frac{-3P_0 D}{4tE} (1 - \mu)$$

**20. (b)**

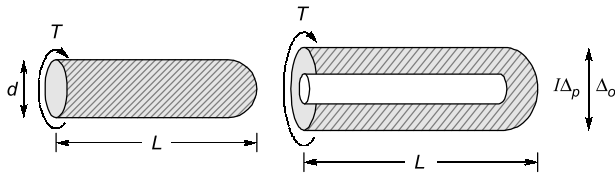
Whenever there is sudden increase or decrease in SFD between two points it indicates there is point load and sudden increase or decrease in BMD between two points it indicates there is moment acting.

**21. (d)**

$$\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$$

$$\tau = \frac{G\theta}{L} \times r$$

For same material, same length and at same distance from centre  $\tau$  will be same.

**23. (a)**

$$\frac{D_i}{D_o} = k = \frac{2}{3}$$

$$T_{\text{solid}} = \left( \frac{\tau J}{r} \right)_{\text{solid}}$$

$$T_{\text{hollow}} = \left( \frac{\tau J}{r} \right)_{\text{hollow}} = \frac{\pi}{16} D_o^3 (1 - K^4) \tau$$

$$T_{\text{hollow}} = T_{\text{solid}}$$

$$\frac{\pi}{16} D_o^3 (1 - K^4) \tau_h = \frac{\pi}{16} D_s^3 \tau_s$$

$$\tau_s = \tau_h \text{ same material}$$

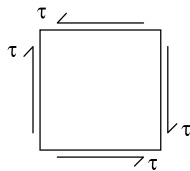
$$\left( \frac{D_o}{d} \right) = \left( \frac{1}{1 - K^4} \right)^{1/3}$$

$$\frac{\text{Weight of hollow shaft}}{\text{Weight of solid shaft}} = \frac{\frac{\pi}{4} (D_o^2 - D_i^2) \times L \times \rho \times g}{\frac{\pi}{4} d^2 \times L \times \rho \times g}$$

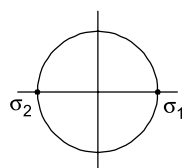
$$= \left( \frac{D_o^2}{d^2} \right) (1 - K^2) = 0.643$$

**24. (a)**

State of pure shear  $\tau$



Mohr circle,



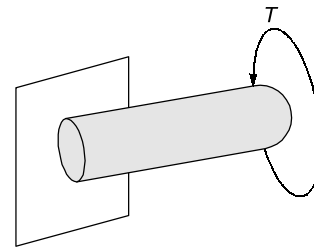
$$\sigma_1 = \tau$$

$$\sigma_2 = -\tau$$

$$\text{Strain energy} = \frac{1}{2} \sigma_1 \epsilon_1 + \frac{1}{2} \sigma_2 \epsilon_2$$

$$= \frac{1}{2} \tau \left( \frac{\tau}{E} + \frac{\mu \tau}{E} \right) + \frac{1}{2} (-\tau) \left( \frac{-\tau}{E} - \frac{\mu \tau}{E} \right)$$

$$= \frac{\tau^2}{E} (1 + \mu)$$

**25. (b)**

$$\frac{T}{J} = \frac{\tau}{r}$$

$$J = \frac{\pi d^4 t}{4}$$

$$r = \frac{d}{2}$$

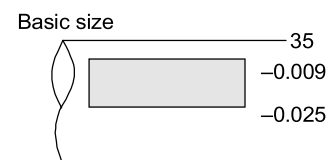
$$\tau = \frac{T}{J} r = \frac{T \cdot \left( \frac{d}{2} \right)}{\frac{\pi d^4 t}{4}}$$

$$= \frac{2T}{\pi t d^2}$$

**26. (b)**

$$\text{Notch sensitivity } (q) = \frac{k_f - 1}{k_t - 1}$$

where  $k_f$  and  $k_t$  are the fatigue stress concentration factor and theoretical stress concentration factor.

**27. (d)**

$$\text{Fundamental deviation} = 0.009$$

$$\text{Tolerance} = -0.009 - (-0.025) = 0.016$$



**28. (d)**Spherical shell circumferential stress ( $\sigma_h$ )

$$\sigma_h = \frac{Pr}{2t}$$

Now, radius increases by 1% and thickness reduced by 1.

$$\Rightarrow \begin{aligned} r' &= 1.01r \\ t' &= 0.99t \end{aligned}$$

$$\begin{aligned} \sigma'_h &= \frac{P(1.01r)}{2(0.99t)} = \frac{Pr}{2t} \times \frac{1.01}{0.99} \\ &= \sigma_h \times 1.0202 \end{aligned}$$

 $\Rightarrow \sigma_h$  increased by 2.02%.**29. (b)**

In multiplate clutch,

Number of pair or contact surfaces =  $n_1 + n_2 - 1$ 

where,

 $n_1$  = Number of disc in shaft 1 $n_2$  = Number of disc in shaft 2**30. (c)**

$$\text{Stiffness } (K) = \frac{Gd^4}{8D^3n}$$

$$\text{i.e. } K \propto \frac{1}{n}$$

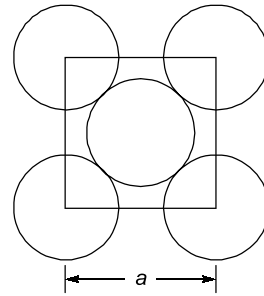
Cut into valves i.e.  $n' = \frac{n}{2}$ , stiffness doubled

$$\Rightarrow K' = 2K$$

**31. (d)**Nickel  $\Rightarrow$  Increases toughness, do not effect ductility.Chromium  $\Rightarrow$  Increases corrosion resistance.Silicon  $\Rightarrow$  Increases hardenability, it is strong deoxidiser.Phosphorus  $\Rightarrow$  Increases hardenability, but result in cold cracking tendency in steel.Sulphur  $\Rightarrow$  Increase hardenability but result in hot cracking tendency in steel.Manganese  $\Rightarrow$  Increase abrasive resistance.Tungsten  $\Rightarrow$  Increase not hardness.Cobalt  $\Rightarrow$  Increase toughness.Vanadium  $\Rightarrow$  Increase endurance strength.**32. (d)**

Commonly used high speed steels:

- 18 - 4 - 1: 18% Tungsten, 4% chromium, 1% Vanadium
- Molybdenum HSS : 6% Molybdenum, 6% tungsten, 4% chromium, 2% Vanadium

**34. (a)**

$$\sqrt{2}a = 4r$$

$$r = \frac{\sqrt{2}a}{4}$$

**35. (d)**

Martensite : It is meta stable crystalization phase of iron formed by the rapid cooling, or quenching or austenite.

**37. (c)**

Twin boundaries are surface defect.

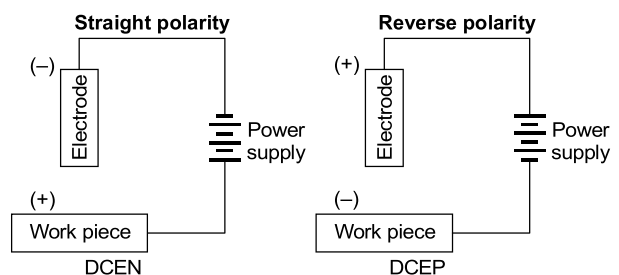
**39. (b)**

$$E = \frac{1}{2} CV_d^2$$

$$\text{MRR} \propto E$$

$$\frac{\text{MRR}_{\text{actual}}}{\text{MRR}_{\text{calculated}}} = \frac{V_{\text{act}}^2}{V_{\text{calculated}}^2}$$

$$= \frac{40^2}{60^2} = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$$

**40. (c)**

# यू.पी.पी.एस.सी.

संयुक्त राज्य अभियांत्रिकी सेवा परीक्षा

**Section-B**

## **Mechanical Engineering**



सामान्य हिन्दी

**Q.1** 'एक तो करेला दूजे नीम चढ़ा' का सही अर्थ निर्देशित कीजिए।

- (a) करेला खाये तो नीम पर न चढ़े।
- (b) नीम पर चढ़ा करेला कढ़वा होता है।
- (c) करेला और नीम दोनों कड़वे होते हैं।
- (d) किसी दुर्जन के साहचर्य से दुष्ट व्यक्ति की दुष्टता में और अधिक वृद्धि।

**Q.2** 'गंगा गये गंगादास, जमुना गये जमुनादास' का अर्थ है।

- (a) संगम में विधिपूर्वक स्नान करना।
- (b) गंगा और यमुना का परम भक्त होना।
- (c) अवसरवादी होना।
- (d) धार्मिक व्यक्ति होना।

**Q.3** शुद्ध वर्तनी वाला शब्द।

- (a) सन्यासी (b) संयासी
- (c) सनयासी (d) संन्यासी

**Q.4** शुद्ध शब्द है

- (a) उपरोक्त (b) उपरियुक्त
- (c) उपर्युक्त (d) उपरिवक्त

**Q.5** निम्नलिखित में कौन सा शब्द पुल्लिङ्ग नहीं है?

- (a) घी (b) पानी
- (c) मनमानी (d) दानी

**Q.6** उर्दू को 'दूसरी राजभाषा' के रूप में मान्यता है

- (a) पश्चिम बंगाल में (b) तमिलनाडू में
- (c) उत्तर-प्रदेश में (d) महाराष्ट्र में

**Q.7** 'एक अनार सौ बीमार'

- (a) मुहावरा है। (b) कहावत है।
- (c) सूक्ति है। (d) कोई नहीं।

**Q.8** समान अर्थ वाला युग्म शब्द है।

- (a) कथा-कत्था (b) कड़ाही-कढ़ाई
- (c) बेला-बेला (d) नीरज-अम्बुज

**Q.9** अंग्रेजी इन्ट्रो (Intro) शब्द का प्रयोग किस क्षेत्र में किया जाता है?

- (a) समाचार लेखन हेतु।
- (b) सचिवालय में प्रवेश हेतु।
- (c) क्रिकेट टीम में सम्मिलित होने हेतु।
- (d) राजकीय सेवा में नियुक्ति हेतु।

**Q.10** 'इन दोनों कमरों ..... एक दीवार है।' रिक्त स्थान की पूर्ति के लिए उपयुक्त शब्द कौन सा है?

- (a) मैं (b) के अन्दर
- (c) के बीच में (d) के बीच

**Q.11** 'मेरी ..... कन्या का विवाह होने जा रहा है।' वाक्य में रिक्त स्थान की पूर्ति के लिए उपयुक्त शब्द है।

- (a) सौभाग्यवती (b) सुहागन
- (c) सौभाग्याकांक्षिणी (d) सौभाग्योत्सुक

**Q.12** निम्नलिखित शब्द समूहों में भिन्न अर्थ देने वाला शब्द है

- (a) पवन (b) मारुत
- (c) अनल (d) समीर

**Q.13** 'संयोग' शब्द का उपयुक्त विलोम है

- (a) अयोग (b) वियोग
- (c) प्रयोग (d) दूयोग

**Q.14** 'पत्थर' का तत्सम शब्द है

- (a) प्रस्तर (b) पाहन
- (c) चट्टान (d) कंक्रीट

**Q.15** निम्नलिखित शब्दों में अव्यय बताइए।

- (a) आया (b) किन्तु
- (c) नहीं (d) वह

**Q.16** जागति का विलोम है

- (a) प्रगति (b) कान्ति  
(c) शान्ति (d) सुषुप्ति

**Q.17** शुद्ध शब्द है

- (a) प्रौद्योगिकी (b) प्रौद्योगीकी  
(c) प्रौद्योगीकि (d) प्रद्योगिकी

**Q.18** शुद्ध वाक्य है

- (a) प्रज्ञाचक्षु को हरा रंग पसन्द है।  
(b) प्रज्ञाचक्षु ने लाल कमल वाला जलाशय देखा।  
(c) प्रज्ञाचक्षु ने चुपचाप सुना।  
(d) प्रज्ञाचक्षु ने दर्पण देखा।

**Q.19** 'नाच न जाने आँगन टेढ़ा' का अर्थ है

- (a) नाच न जानना।  
(b) आँगन में दोष होना।  
(c) आँगन टेढ़े होने से नाच न आना।  
(d) अपनी आयोध्यता छिपाने के लिए साधन को दोष देना।

**Q.20** 'रंगा सियार' का अर्थ है

- (a) धूर्त आदमी। (b) औसत सियारों से अलग।  
(c) सुन्दर सियार। (d) अन्धा सियार।

**Q.21** 'हिमकर' का विलोम है

- (a) शशिकर (b) शीतकर  
(c) सुखद (d) दिनकर

**Q.22** भोजपुरी किस जिले में नहीं बोली जाती है?

- (a) वाराणसी (b) आजमगढ़  
(c) इटावा (d) गोरखपुर

**Q.23** निम्नलिखित में एक वर्गीय व्यंजन नहीं है

- (a) च (b) क  
(c) त (d) ह

**Q.24** हिन्दी की वह बोली जो देश के बाहर भी बोली जाती है

- (a) खड़ी बोली (b) भोजपुरी  
(c) छत्तीसगढ़ी (d) बुन्देलखण्डी

**Q.25** खड़ी बोली के कवि हैं

- (a) तुलसीदास  
(b) सूरदास  
(c) अयोध्यासिंह उपाध्याय 'हरिऔध'  
(d) देव

**Q.26** 'आई' प्रत्यय किस शब्द में नहीं है?

- (a) विदाई (b) खाई  
(c) ढिठाई (d) चिकनाई

**Q.27** 'उसके गले में बेड़ी पड़ी थी' वाक्य अशुद्ध है क्योंकि

- (a) क्रिया अशुद्ध है।  
(b) काल दोष है।  
(c) 'बेड़ी' गले में नहीं पड़ती।  
(d) वचन दोष है।

**Q.28** 'सीमा, जाओ बाहर खेलो' कैसा वाक्य है?

- (a) इच्छाबोधक (b) आज्ञावाचक  
(c) संकेतार्थक (d) निषेधात्मक

**Q.29** जो कठिनाई से समझ में आये

- (a) दुर्बोध (b) दुष्कर  
(c) कठिन (d) उलझनयुक्त

**Q.30** कौन सा शब्द 'सु' उपसर्ग से नहीं बना है?

- (a) सुकर्म (b) सुगम  
(c) सुअर (d) सुमन

**Q.31** निम्नलिखित वाक्य में रिक्त स्थान की पूर्ति हेतु सही विकल्प को चिह्नांकित कीजिए

हमें गरीबों ..... दया करनी चाहिए।

- (a) के ऊपर (b) से  
(c) के लिए (d) पर

**Q.32** 'सदैव रहने वाला' अर्थ को प्रकट करता है

- (a) सामयिक (b) समसाययिक  
(c) शाश्वत (d) पुरातन

**Q.33** गौतमबुद्ध के प्रवचन किस भाषा में हैं?

- (a) संस्कृत (b) प्रकृत  
(c) पालि (d) हिन्दी

**Q.34** विनयपत्रिका की भाषा है

- (a) अवधी (b) ब्रजभाषा  
(c) खड़ी बोली (d) भोजपुरी

**Q.35** इनमें से कौन भाषा वैज्ञानिक नहीं है?

- (a) जार्ज प्रिंसर्सन (b) डॉ. हरदेव बाहरी  
(c) सुभद्राकुमारी चौहान (d) डॉ. भोलानाथ तिवारी

**Q.97** शुद्ध वाक्य निर्देशित कीजिए।

- (a) यह रुमाल अच्छी है।
- (b) पटना में दही बहुत खट्टी है।
- (c) कई हाथियाँ जा रही हैं।
- (d) उसका मकान अच्छा है।

**Q.98** वह शब्दयुग्म जिसमें पुनरुक्ति दोष नहीं है

- (a) काला कोयला      (b) गर्म आग
- (c) ठण्डी बर्फ      (d) गर्म हवा

**Q.99** 'गड़े मुर्दे उखाड़ना' का सही अर्थ है

- (a) मुर्दों का व्यापार करना
- (b) कब्र खोदना
- (c) पुरानी विस्मृत बातों की चर्चा करना
- (d) पुरातात्विक उत्खनन कार्य

**Q.100** 'पानी फेर देना' का तात्पर्य है

- (a) किसी के ऊपर पानी डाल देना
- (b) पानी की धार से चारों ओर घेरा बनाना
- (c) किया-कराया नष्ट कर देना
- (d) पानी के इर्द-गिर्द घूमना

■■■■

### उत्तरमाला | सामान्य हिन्दी ( वर्ष 2004 )

- |         |         |         |         |         |         |          |
|---------|---------|---------|---------|---------|---------|----------|
| 1. (d)  | 16. (d) | 31. (d) | 46. (b) | 61. (a) | 76. (a) | 91. (b)  |
| 2. (c)  | 17. (a) | 32. (c) | 47. (d) | 62. (a) | 77. (b) | 92. (d)  |
| 3. (d)  | 18. (a) | 33. (c) | 48. (a) | 63. (c) | 78. (d) | 93. (c)  |
| 4. (c)  | 19. (d) | 34. (b) | 49. (a) | 64. (a) | 79. (a) | 94. (a)  |
| 5. (c)  | 20. (a) | 35. (c) | 50. (d) | 65. (b) | 80. (c) | 95. (b)  |
| 6. (c)  | 21. (d) | 36. (c) | 51. (b) | 66. (d) | 81. (d) | 96. (c)  |
| 7. (b)  | 22. (c) | 37. (d) | 52. (c) | 67. (d) | 82. (d) | 97. (d)  |
| 8. (d)  | 23. (*) | 38. (b) | 53. (b) | 68. (d) | 83. (b) | 98. (d)  |
| 9. (a)  | 24. (b) | 39. (b) | 54. (a) | 69. (c) | 84. (d) | 99. (c)  |
| 10. (c) | 25. (c) | 40. (a) | 55. (a) | 70. (c) | 85. (c) | 100. (c) |
| 11. (c) | 26. (b) | 41. (d) | 56. (d) | 71. (d) | 86. (c) |          |
| 12. (c) | 27. (a) | 42. (d) | 57. (a) | 72. (d) | 87. (d) |          |
| 13. (b) | 28. (b) | 43. (b) | 58. (b) | 73. (d) | 88. (d) |          |
| 14. (a) | 29. (a) | 44. (d) | 59. (d) | 74. (a) | 89. (d) |          |
| 15. (b) | 30. (c) | 45. (c) | 60. (b) | 75. (c) | 90. (d) |          |

●●●●

## व्याख्या | सामान्य हिन्दी ( वर्ष 2004 )

1. (d) 'एक तो करेला दूजे नीम चढ़ा' का अर्थ है— किसी दुर्जन के साहचर्य से दुष्ट व्यक्ति की दुष्टता में और अधिक वृद्धि।  
अतः विकल्प (d) सही है।
2. (c) 'गंगा गये गंगा दास, जमुना गये जमुना दास' का अर्थ है।  
अवसरवादी होना।  
अतः विकल्प (c) सही है।
3. (d) शुद्ध शब्द: संन्यासी  
अतः विकल्प (d) सही है।
4. (c) शुद्ध शब्द: उपर्युक्त  
अतः विकल्प (c) सही है।
5. (c) शब्द 'मनमानी' पुल्लिङ्ग नहीं है।  
अतः विकल्प (c) सही है।
6. (c) उर्दू को उत्तर-प्रदेश में दूसरी राजभाषा के रूप में मान्यता है।  
अतः विकल्प (c) सही है।
7. (b) 'एक अनार सौ बीमार' एक कहावत है।  
अतः विकल्प (b) सही है।
8. (d) नीरज और अम्बुज 'कमल' के पर्यायवाची हैं।  
अतः विकल्प (d) सही है।
10. (c) 'इन दोनों कमरों के बीच में एक दीवार है।'  
अतः विकल्प (c) सही है।
11. (c) मेरी सौभाग्याकांक्षिणी कन्या का विवाह होने जा रहा है।  
अतः विकल्प (c) सही है।
12. (c) पवन, मारुत, समीर शब्द 'वायु' के पर्यायवाची हैं जबकि अनल का अर्थ है 'अग्नि'।  
अतः विकल्प (c) सही है।
13. (b) 'संयोग' शब्द का विलामे है— 'वियोग'  
अतः विकल्प (b) सही है।
14. (a) 'पत्थर' का तत्सम शब्द है— 'प्रस्तर'  
अतः विकल्प (c) सही है।
16. (d) 'जागति' का विलोम है— 'सुषुप्ति'  
अतः विकल्प (d) सही है।
17. (a) शुद्ध शब्द: प्रौद्योगिकी  
अतः विकल्प (a) सही है।
19. (d) 'नाच न जाने आँगन टेढ़ा' का अर्थ है— अपनी अयोग्यता छिपाने के लिए साधन को दोष देना।  
अतः विकल्प (d) सही है।
20. (a) रंगा सियार का अर्थ है— 'धूर्त आदमी'  
अतः विकल्प (a) सही है।
21. (d) हिमकर (चन्द्रमा) का विलोम है दिनकर (सूर्य)।  
अतः विकल्प (d) सही है।
22. (c) इटावा ब्रज भावा का क्षेत्र है। अतः भोजपुरी इटावा जिले में नहीं बोली जाती है।
23. (\*) 'च' वर्ग च, छ, ज, झ, ञ  
'क' वर्ग क, ख, ग, घ, ङ  
'त' वर्ग त, थ, द, ध, न  
ऊष्म श, ष, स, ह
24. (b) भोजपुरी बोली का प्रसार भारत के बाहर सूरीनाम, फिजी, मारिशस, गयाना, त्रिनिडाड में है। इस दृष्टि से भोजपुरी अंतर्राष्ट्रीय महत्व की बोली है।  
अतः विकल्प (b) सही है।
25. (c) अयोध्या सिंह 'हरिऔध' खड़ी बोली के कवि हैं।  
अतः विकल्प (c) सही है।
26. (b) 'आई' प्रत्यय 'खाई' शब्द में नहीं लगा है।  
अतः विकल्प (b) सही है।
28. (b) 'सीमा, जाओ बाहर खेलो' एक आज्ञावाचक वाक्य है।  
अतः विकल्प (b) सही है।
29. (a) जो कठिनाई से समझ में आये— 'दुर्बोध'  
अतः विकल्प (a) सही है।
30. (c)

उपसर्ग	+	मूल शब्द	=	शब्द
सु	+	कर्म	=	सुकर्म
सु	+	गम	=	सुगम
सु	+	मन	=	सुमन

अतः शब्द 'सुअर' में 'सु' उपसर्ग नहीं है।

# UPPSC-AE

Combined State Engineering  
Services Examination

## Section-C

# Mechanical Engineering



*Topicwise*  
**General Studies**

## 2007(I)

- Q.1** It is believed that deposits of cholesterol in the body are responsible for:  
(a) tooth decay (b) liver disorders  
(c) heart disorders (d) cancer
- Q.2** Which one of the following chemicals is used to preserve food material?  
(a) Caustic soda (b) Sodium benzoate  
(c) Sodium chloride (d) Sulphuric acid
- Q.3** Which one of the following diseases is not caused by virus?  
(a) polio (b) small pox  
(c) tuberculosis (d) AIDS
- Q.4** The depth of oceans is usually measured in:  
(a) feet (b) fathoms  
(c) metres (d) nautical miles
- Q.5** 'Jarvik-7' is:  
(a) electronic leg (b) pace maker  
(c) artificial heart (d) artificial eye
- Q.6** Which one of the following statements is not correct?  
(a) Iron sinks in water  
(b) Iron floats in mercury  
(c) Mercury floats in water  
(d) Wood floats in water
- Q.7** Ozone absorbs solar radiation in the range of  
(a) 240 to 280  $\mu\text{m}$  (b) 280 to 320  $\mu\text{m}$   
(c) 320 to 400  $\mu\text{m}$  (d) 400 to 700  $\mu\text{m}$
- Q.8** Which one of the following Vitamins helps in the process of blood clotting?  
(a) Vitamin C (b) Vitamin D  
(c) Vitamin E (d) Vitamin K
- Q.9** Which one of the following forms an irreversible complex with haemoglobin of the blood?  
(a) Carbon-dioxide  
(b) Pure Nitrogen gas  
(c) Carbon monoxide  
(d) Mixture of Carbon-dioxide and Helium
- Q.10** Which one of the following expresses error in computer data?  
(a) chip (b) byte  
(c) bug (d) bit
- Q.11** India won the legal battle against the USA in the patenting of the medicinal plant of:  
(a) Neem (b) Haldi  
(c) Tulsi (d) Pudina
- Q.12** Which one of the following is responsible for the colour of the skin?  
(a) Enzymes (b) Epidermis  
(c) Hormones (d) Melanin
- Q.13** Energy required for the process of food manufacture in green plants comes from:  
(a) oxygen (b) carbon dioxide  
(c) glucose (d) sunlight
- Q.14** Which one of the following statements is not true?  
(a) Apple was introduced in India from outside  
(b) Apple is rich in roughage  
(c) Apple has high content of calcium  
(d) Apple has high content of iron
- Q.15** The vaccine for polio was first prepared by:  
(a) Paul Ehrlich (b) Joseph Lister  
(c) Louis Pasteur (d) Jonas Salk

## 2007(II)

- Q.16** Cyanide poisoning causes immediate death as it directly affects  
(a) perspiration  
(b) cellular respiration



- (c) blood circulation  
(d) digestion
- Q.17** The Apollo Mission of NASA could map only 25% of the total Moon surface. India's Chandrayan-I mapped what percentage of Moon surface?  
(a) 75% (b) 80%  
(c) 90% (d) 95%
- Q.18** Waves transmit from one place to another  
(a) Mass (b) Amplitude  
(c) Wavelength (d) Energy
- Q.19** Lanolin - a type of wax used for making ointments is obtained from  
(a) Palm tree (b) Rubber tree  
(c) Wool (d) Bees
- Q.20** Kinetic energy of a body is  
(a) a vector quantity  
(b) a scalar quantity  
(c) proportional to its weight  
(d) proportional to its momentum
- Q.21** Absolute zero may be regarded as that temperature at which  
(a) water freezes  
(b) all gases become liquid  
(c) molecular motion in a gas would cease  
(d) all substances are solid
- Q.22** Metals are good conductors of heat because  
(a) their atoms collide infrequently  
(b) their atoms are relatively far apart  
(c) they contain free electron  
(d) they have reflecting surfaces
- Q.23** Permanent magnets are made from  
(a) Diamagnetic substances  
(b) Ferromagnetic substances  
(c) Paramagnetic substances  
(d) Dielectric substances
- Q.24** Match the Indian Scientists with the disciplines they are associated with. Find your answer from the given code:

**Scientists**

- A.** R.C. Bose  
**B.** Satyendra Nath Bose

- C.** Dr. Shambhu Nath  
**D.** Dr. Nil Ratan Dhar

**Disciplines**

1. Chemistry  
2. Experimental Pathology  
3. Physics  
4. Mathematics

**Codes:**

	A	B	C	D
(a)	4	3	2	1
(b)	1	2	3	4
(c)	3	4	1	2
(d)	2	1	4	3

- Q.25** Fish can survive inside a frozen lake because  
(a) fish are cold blooded animals  
(b) fish can breathe when embedded in ice  
(c) fish move to the bottom of the lake where water is at 4°C  
(d) fish move to the top of the lake where water is at 4°C
- Q.26** The shortest wavelength is for  
(a)  $\gamma$ -rays (b) X-rays  
(c) ultra-violet rays (d) microwaves
- Q.27** The flying of birds is a proof of Newton's  
(a) third law of motion  
(b) second law of motion  
(c) first law of motion  
(d) both second and third law of motion
- Q.28** In a Doctor's stethoscope, the sound is intensified because of  
(a) reflection of sound  
(b) resonance of sound  
(c) constructive interference  
(d) principle of superimposition of waves
- Q.29** Which of the following waves/rays are used in sonography?  
(a) micro-waves (b) infrared rays  
(c) ultrasonic waves (d) sound waves
- Q.30** Teflon is a/an  
(a) insecticide (b) polymer  
(c) drug (d) dye
- Q.31** The metal present in Haemoglobin is  
(a) Magnesium (b) Copper  
(c) Zinc (d) Iron

**Answers | General Science**

1. (a)	18. (d)	35. (c)	52. (b)	69. (b)	86. (c)
2. (b)	19. (c)	36. (b)	53. (c)	70. (c)	87. (b)
3. (c)	20. (d)	37. (b)	54. (d)	71. (a)	88. (d)
4. (b)	21. (c)	38. (d)	55. (d)	72. (b)	89. (a)
5. (c)	22. (c)	39. (b)	56. (a)	73. (b)	90. (b)
6. (c)	23. (b)	40. (d)	57. (a)	74. (c)	91. (d)
7. (a)	24. (a)	41. (d)	58. (d)	75. (c)	92. (a)
8. (d)	25. (c)	42. (b)	59. (b)	76. (c)	93. (c)
9. (c)	26. (a)	43. (a)	60. (c)	77. (d)	94. (b)
10. (c)	27. (a)	44. (a)	61. (d)	78. (c)	95. (d)
11. (a)	28. (a)	45. (a)	62. (b)	79. (d)	96. (c)
12. (d)	29. (c)	46. (b)	63. (a)	80. (d)	97. (b)
13. (d)	30. (b)	47. (a)	64. (b)	81. (b)	98. (c)
14. (b)	31. (d)	48. (d)	65. (b)	82. (a)	
15. (d)	32. (c)	49. (a)	66. (c)	83. (b)	
16. (b)	33. (b)	50. (b)	67. (d)	84. (b)	
17. (d)	34. (d)	51. (b)	68. (b)	85. (a)	

**Explanations | General Science****1. (c)**

Cholesterol is a type of Fat (lipid) made by our body. It is essential for good health and is found in every cell in our body however, having a high level of certain type of Cholesterol in our blood (hyper cholesteralaemia) can increase. Possibility of cardiovascular disease, such as heart disease and stroke. High Cholesterol fatty deposit (knows plaques) to built up inside our blood vessels. In time, the blood vessels supplying our heart may become so narrow they can't deliver oxygen to our heart. Muscle, particularly when we are exerting ourselves. This can cause chest pain. If a fatty plaque breaks off it may cause a blood clot that can block blood flow to our heart (heart attack) or if the same process occurs in your brain it may cause a stroke.

**2. (b)**

**Sodium benzoate** and other benzoates are the principle organic chemicals used as food preservatives. The use of benzoates in certain products in prescribed quantity (usually not exceeding 0.1 percent) is permitted in most countries. Sometimes, sodium chloride is also used as food preservative as preservation of meat, fishes, pickles etc.

**3. (c)**

Tuberculosis, commonly known as TB, is a bacterial infection that can spread through the lymph nodes and blood stream to any organ in our body. It is most after found in the lungs. Most people who are exposed to TB never develop symptoms because the bacteria can live in an inactive form in the body. But if the immune

- system weakens, such as in people with HIV or elderly adults. TB bacteria can become active in their active state, it can cause death of tissue in the organs they infect. Active TB disease can be fatal if left untreated.
4. (b)  
The depth of oceans is measured in fathom. One fathom is equals to 6 feet or 1.8288 meters, is a unit of length in the old imperial and U.S. Customary systems used especially for measuring the depth of water.
5. (c)  
The Jarvik 7 is a artificial heart probably best known as artificial heart device. It was designed by Dr. Jarvik, to function like the Natural heart.
6. (c)  
Mercury has higher density than Iron, so Iron floats in mercury.
8. (d)  
Vitamin K is a necessary component of the body's ability to clot blood, without its function, a small cut could result in uncontrolled bleeding. In addition, vitamin K has an important role in the formation of bone. Higher level of Vitamin K means more calcium in the bone, increased bone density, and less risk of fracture.
9. (c)  
Carbon monoxide makes carboxy-haemo-globin when reactions with haemoglobin. The process is irreversible.
12. (d)  
Melanin is a pigment found in skin of human responsible for colour. In African race of people it is very high where as in European race people it is absent or very less in quantity, the high quantity of melanin protected the skin from rays so decrease the threat of skin cancer. Where as European people or white people are susceptible to skin cancer because they have very less melanin in skin.
13. (d)  
Energy required for the process of food manufacturing in green plants (in Photosynthesis) comes from sunlight. Plants in presence of water, chlorophyll and sunlight make food and the process is called photosynthesis.
14. (b)  
Apple was introduced in India from middle east countries.
15. (d)
  - Two polio vaccines are used throughout the world to combat poliomyelitis (or Polio). The first was developed by Jonas Salk and first tested in 1952. It consists of an injected dose of inactivated (dead) polio virus.
  - Another, oral (or Modern) Polio vaccine was developed by Albert Sabin using attenuated polio virus. Human trials of Sabin's vaccine began in 1957.
16. (b)  
The cyanide ion ( $\text{CN}^-$ ) halts cellular respiration by inhibiting an enzyme in the mitochondria called cytochrome C oxidase.  
Cyanide poisoning is a form of histotoxic hypoxia because the cells of organism are unable to use oxygen, primarily through the inhibition of cytochrome C oxidase.  
Acute hydrogen cyanide poisoning can result from inhalation of fumes from burning polymer products that use nitrites in their production, such as wool, silk, polyurethanes or vinyl.
17. (d)  
Chandrayaan-1 was the India's lunar mission launched on 22nd October 2008 from PSLV-C11 by ISRO. It was operated by NASA.  
Chandrayaan-1 operated for 312 days as opposed to the intended two years but mission achieved 95 percent of its planned objectives including mapping over 95 % of the lunar surface with the  $\text{M}^3$  instrument (Moon Mineralogy Mapper).  $\text{M}^3$  is an imaging spectrometer that has provided the first-high resolution spatial and spectral map of the entire lunar surface, revealing the minerals of which it is made.