

## Paper – Mechanical Engineering

### PART – I : OBJECTIVE / MCQ

Each question carries 2 marks:

(75X2= 150 Marks

Answer all questions

.....75 x 2 = 150

- Euler's formula holds good only for  
A. short columns    B. long columns    C. both short and long columns    D. weak columns
- The stress induced in a body, when suddenly loaded, is \_\_\_\_\_ the stress induced when the same load is applied gradually.  
A. equal to    B. one-half    C. twice    D. four times
- Two closely coiled helical springs 'A' and 'B' are equal in all respects but the number of turns of spring 'A' is half that of spring 'B' The ratio of deflections in spring 'A' to spring 'B' is  
A. 1/8    B. 1/4    C. 1/2    D. 2
- A thin cylindrical shell of diameter ( $d$ ) and thickness ( $t$ ) is subjected to an internal pressure ( $p$ ). The ratio of longitudinal strain to volumetric strain is  
A.  $\frac{m - 1}{2m - 1}$   
B.  $\frac{2m - 1}{m - 1}$   
C.  $\frac{m - 2}{3m - 4}$   
D.  $\frac{m - 2}{5m - 4}$
- When a rectangular beam is loaded transversely, the maximum compressive stress is developed on the  
A.. top layer    B. bottom layer    C. neutral axis    D. every cross-section
- When shear force at a point is zero, then bending moment is \_\_\_\_\_ at that point.  
A. zero    B. minimum    c. Maximum    D. infinity

7. A thin spherical shell of diameter ( $d$ ) and thickness ( $t$ ) is subjected to an internal pressure ( $p$ ). The stress in the shell material is  
 A.  $pd/t$  B.  $pd/2t$  C.  $pd/4t$  D.  $pd/8t$
8. The polar moment of inertia of a hollow shaft of outer diameter ( $D$ ) and inner diameter ( $d$ ) is  
 A.  $\frac{\pi}{16} (D^3 - d^3)$   
 B.  $\frac{\pi}{16} (D^4 - d^4)$   
 C.  $\frac{\pi}{32} (D^4 - d^4)$   
 D.  $\frac{\pi}{64} (D^4 - d^4)$
9. The strain energy stored in a spring, when subjected to maximum load, without suffering permanent distortion, is known as  
 A. impact energy B. proof resilience C. proof stress D. modulus of resilience
10. The ductility of a material \_\_\_\_\_ with the increase in percentage reduction in area of a specimen under tensile test.  
 A. increases B. decreases C. remains same
11. The pair is known as a higher pair, when the relative motion between the elements of a pair is  
 A. turning only B. sliding only C. rolling only D. partly turning and partly sliding
12. The gear train usually employed in clocks is a  
 A. simple gear train B. reverted gear train C. sun and planet gear D. differential gear
13. For an involute gear, the ratio of base circle radius and pitch circle radius is equal to  
 A.  $\sin \phi$  B.  $\cos \phi$  C.  $\sec \phi$  D.  $\operatorname{cosec} \phi$
14. When the speed of the engine fluctuates continuously above and below the mean speed, the governor is said to be  
 A. stable B. unstable C. isochronous D. hunt

15. The velocity of a particle moving with simple harmonic motion, at any instant is given by (where  $\omega$  = Displacement of the particle from mean position)

A.  $\omega \sqrt{x^2 - r^2}$

B.  $\omega \sqrt{r^2 - x^2}$

C.  $\omega^2 \sqrt{x^2 - r^2}$

D.  $\omega^2 \sqrt{r^2 - x^2}$

16. The frictional torque transmitted in a flat pivot bearing, considering uniform wear, is (where  $\mu$  = Coefficient of friction,  $W$  = Load over the bearing, and  $R$  = Radius of bearing surface)

A.  $\frac{1}{2} \mu W R$

B.  $\frac{2}{3} \mu W R$

C.  $\frac{3}{4} \mu W R$

D.  $\mu W R$

17. The relation between number of pairs ( $p$ ) forming a kinematic chain and the number of links ( $l$ ) is

A.  $l = 2p - 2$  B.  $l = 2p - 3$  C.  $l = 2p - 4$  D.  $l = 2p - 5$

18. A shaft carrying three rotors will have

A. no node B. one node C. two nodes D. three nodes

19. Which of the following is an open pair?

A. ball and socket joint B. journal bearing C. lead screw and nut D. cam and follower

20. In a gear having involute teeth, the normal to the involute is a tangent to the

A. pitch circle B. base circle C. addendum circle D. dedendum circle

21. An eutectoid steel consists of

A. wholly pearlite B. wholly austenite C. pearlite and ferrite D. pearlite and cementite

22. The percentage of carbon in cast iron varies from  
A. 0.1 to 0.5 B. 0.5 to 1 C. 1 to 1.7 D. 1.7 to 4.5
23. The ability of a material to absorb energy in the plastic range is called  
A. resilience B. creep C. fatigue strength D. toughness
24. Internal gears can be made by  
A. hobbing B. shaping with pinion cutter C. shaping with rack cutter D. milling
25. Drilling is an example of  
A. orthogonal cutting B. oblique cutting C. simple cutting D. uniform cutting
26. A single point thread cutting tool should ideally have  
A. zero rake angle B. positive rake angle C. negative rake angle D. point angle
27. The lead screw of a lathe has \_\_\_\_\_ threads.  
A. single start B. double start C. multi-start D. any one of these
28. Which of the following operations can be performed with milling cutters?  
A. cutting key ways on shafts B. cutting external screw threads  
C. cutting teeth of spur gears D. all of these
29. The size of a shaper is given by  
A. stroke length B. motor power C. mass of machine D. rate size
30. Tool life is generally better when  
A. grain size of the metal is large B. grain size of the metal is small  
C. hard constituents are present in the microstructure of the tool material D. none of the above
31. The size of a lathe is specified by the  
A. length between centres B. swing diameter over the bed  
C. swing diameter over the carriage D. all of these
32. Gears can be best produced on mass production by  
A. shaping B. casting C. forming D. hobbing
33. The chamfering is an essential operation after

- A. knurling B. rough turning C. boring D. thread cutting
34. In inventory control theory, the economic order quantity is  
A. average level of inventory B. optimum lot size C. capacity of a warehouse  
D. lot size corresponding to break-even analysis
35. Fixed position layout is also known as  
A. analytical layout B. synthetic layout C. static product layout D. none of these
36. Probabilistic time for completion of any activity can be found out from  
A. optimistic time B. pessimistic time C. most likely time D. all of these
37. PERT requires  
A. single time estimate B. double time estimate C. triple time estimate  
D. none of these
38. In a line organisation  
A. responsibility of each individual is fixed B. discipline is strong  
C. quick decisions are taken D. all of these
39. A cycle consisting of one constant pressure, one constant volume and two isentropic processes is known as  
A. Carnot cycle B. Stirling cycle C. Otto cycle D. Diesel cycle
40. The processes occurring in open system which permit the transfer of mass to and from the system, are known as  
A. flow processes B. non-flow processes C. adiabatic processes D. none of these
41. Work done in a free expansion process is  
A. Zero B. minimum C. Maximum D. positive
42. The entropy \_\_\_\_\_ in an irreversible cyclic process.  
A. remains constant B. decreases C. increases
43. The efficiency of Joule cycle is  
A. greater than Carnot cycle B. less than Carnot cycle C. equal to Carnot cycle

- D. none of these
44. The heat transfer takes place according to  
A. Zeroth law of thermodynamics B. First law of thermodynamics  
C. Second law of thermodynamics D. Kirchhoff's law
45. A perfect black body is one which  
A. is black in colour B. absorbs heat radiations of all wave lengths falling on it  
C. reflects all the heat radiations D. transmits the heat radiations
46. The subcooling in a refrigeration cycle  
A. does not alter C.O.P. B. increases C.O.P. C. decreases C.O.P. D. none of these
47. The automobile radiator is a heat exchanger of  
A. parallel flow type B. counter flow type C. cross flow type D. regenerator type
48. Bell-Coleman cycle is a  
A. reversed Carnot cycle B. reversed Otto cycle C. reversed Joule cycle  
D. reversed Rankine cycle
49. Thermal diffusivity of a substance is  
A. directly proportional to the thermal conductivity B. inversely proportional to specific heat  
C. inversely proportional to density of substance D. all of the above
50. During a refrigeration cycle, heat is rejected by the refrigerant in a  
A. compressor B. condenser C. evaporator D. expansion valve
51. For ammonia refrigerating systems, the tubes of a shell and tube condenser are made of  
A. copper B. aluminium C. steel D. brass
52. The C.O.P. of an absorption type refrigerator is given by (where  $T_1$  = Temperature at which the working substance receives heat,  $T_2$  = Temperature of cooling water, and  $T_3$  = Evaporator temperature)  
A.  $\frac{T_1(T_2 - T_3)}{T_3(T_1 - T_2)}$

B.  $\frac{T_3(T_1 - T_2)}{T_1(T_2 - T_3)}$

C.  $\frac{T_1(T_1 - T_2)}{T_3(T_2 - T_3)}$

D.  $\frac{T_3(T_2 - T_3)}{T_1(T_1 - T_2)}$

53. The thickness of thermal and hydrodynamic boundary layer is equal if Prandtl number is  
A. equal to one B. greater than one C. less than one D. equal to Nusselt number
54. In a glass tube type water indicator for a boiler, one end of the tube is connected to water space and the other end is connected to  
A. water space also B. chimney C. steam space D. superheater
55. A device used to increase the temperature of saturated steam without raising its pressure, is called  
A. blow off cock B. fusible plug C. superheater D. stop valve
56. An air preheater is installed  
A. before the economiser B. before the superheater C. between the economiser and chimney  
D. none of these
57. The actual power supplied by the engine crankshaft is called  
A. indicated power B. brake power C. frictional power D. none of these
58. The object of supercharging the engine is  
A. to reduce mass of the engine per brake power B. to reduce space occupied by the engine  
C. to increase the power output of an engine when greater power is required  
D. all of the above
59. In a diesel engine, the duration between the time of injection and ignition, is known as  
A. pre-ignition period B. delay period C. period of ignition D. burning period
60. The maximum temperature in a gas turbine is  
A. 200°C B. 500°C C. 700°C D. 1000°C

61. The stagnation pressure rise in a centrifugal compressor takes place  
 A. in the diffuser only    B. in the impeller only    C. in the diffuser and impeller  
 D. in the inlet guide vanes only
62. In one dimensional flow, the flow  
 A. is steady and uniform    B. takes place in straight line    C. takes place in curve  
 D. takes place in one direction
63. Which of the following is an example of laminar flow?  
 A. underground flow    B. flow past tiny bodies    C. flow of oil in measuring instruments  
 D. all of these
64. The centre of gravity of the volume of the liquid displaced is called  
 A. centre of pressure    B. centre of buoyancy    C. metacentre    D. none of these
65. The power transmitted through a pipe is (where  $w$  = Specific weight in  $\text{N/m}^3$ , and  $Q$  = Discharge in  $\text{m}^3/\text{s}$ )  
 A.  $w \times Q \times H$     B.  $w \times Q \times h_f$     C.  $w \times Q (H - h_f)$     D.  $w \times Q (H + h_f)$
66. A flow through a long pipe at constant rate is called  
 A. steady uniform flow    B. steady non-uniform flow    C. unsteady uniform flow  
 D. unsteady non-uniform flow
67. When the Mach number is less than unity, the flow is called  
 A. sub-sonic flow    B. sonic flow    C. super-sonic flow    D. hyper-sonic flow
68. The velocity at which the flow changes from laminar flow to turbulent flow is called  
 A. critical velocity    B. velocity of approach    C. sub-sonic velocity  
 D. super-sonic velocity
69. A fluid whose viscosity does not change with the rate of deformation or shear strain is known as  
 A. real fluid    B. ideal fluid    C. Newtonian fluid    D. non-Newtonian fluid



70. Newton's law of viscosity is a relationship between
- A. pressure, velocity and temperature
  - B. shear stress and rate of shear strain
  - C. shear stress and velocity
  - D. rate of shear strain and temperature
71. In arc welding, the electric arc is produced between the work and the electrode by
- A. voltage
  - B. flow of current
  - C. contact resistance
  - D. all of these
72. Which of the following methods can be used for manufacturing 2 metre long seamless metallic tubes?
- A. drawing
  - B. extrusion
  - C. rolling
  - D. extrusion and rolling
73. The machining allowance provided on patterns depends upon
- A. type of casting metal
  - B. size and shape of casting
  - C. method of casting used
  - D. all of these
74. The electrodes used in spot welding have a tip of
- A. stainless steel
  - B. aluminium
  - C. copper
  - D. brass
75. The centrifugal casting method, is used for casting articles of
- A. symmetrical shape about vertical axis
  - B. symmetrical shape about horizontal axis
  - C. irregular shape
  - D. non-ferrous metal only

## PART – II

**Subjective / conventional : Marks: 150**

This paper consists of : A - 10 question of 5 marks each.....50 Marks

B - 5 question of 10 marks each.....50 Marks

C - 2 question of 25 marks each.....50 Marks

**A. Attempt only 10 questions, each question carries 5 marks.**

1. Differentiate between scheduling and loading.
2. What is simple harmonic motion? How much phase differences do velocity and acceleration have with displacement in S.H.M. ?
3. What do you mean by a mechanism? Name the inversions of a four bar cyclic chain.
4. Write the stresses induced in a helical spring of circular wire along with their expressions.
5. How metal is formed in rolling?
6. What is forging? Name the common forging methods.
7. How break even point is reached?
8. How gears are classified based on the position of the axes of the shafts? Give examples.
9. What do you mean by “perpetual motion machine of kind 1” ?
10. On what cycle does diesel engine works? Show the P-V diagram of the cycle.
11. Write the expressions for dynamic and kinematic viscosity. What are the SI units for them?
12. State Fourier’s law of conduction of heat.
13. How do boiler accessories differ from mountings?
14. Name the cycles on which an air refrigeration system can work. What is C.O.P. ?

**B. Attempt only 5 questions, each question carries 10 marks.**

1. Prove that in a thin cylinder longitudinal stress is equal to half the hoop stress.
2. Differentiate between a flywheel and a governor.
3. Discuss in brief submerged arc welding and thermit welding processes.
4. Define work study. What are the objectives and importance of it?
5. Write the Clausius Statement and derive Clausius inequality.
6. Petrol (vapour pressure = 54.5 KPa absolute, density =  $675 \text{ Kg/m}^3$ ) flows through a pipe constriction, where the diameter is reduced from 250 mm to 150 mm. The pressure in the upstream of the pipe is 60 KPa. If the atmospheric pressure is 750 mm of mercury, calculate the maximum discharge that can be passed through this constriction.
7. What is thermal conductivity? Derive the relation for heat conduction through a wall.
8. What are the differences between a laminar and a turbulent flow? What is equation of continuity?

# Staff in Public Service Commission

Area: Engineering Examination for the Post of 'Staff in Public Service Commission'

OPTIONAL PAPER - MECHANICAL ENGINEERING

**C. Attempt only 2 questions, each question carries 25 marks.**

## INSTRUCTIONS TO CANDIDATES

1. a) Define static & dynamic balancing.  
b) A shaft carries four masses in parallel planes A, B, C & D in order along a shaft. Masses B & C weigh 18 kg & 12.5 Kg respectively and each has an eccentricity of 6 cm. The masses at A & D have an eccentricity of 8 cm. Angle between the masses at B & C is  $100^\circ$  and that between the masses at B & A is  $190^\circ$  both measured in the same sense. The axial distance between the planes A & B is 10 cm and between B & C is 20 cm. If the shaft is in complete dynamic balance determine :
  - (i) the weight of masses at A & D
  - (ii) the distance between planes C & D.
  - (iii) angular position of mass D.
2. a) What is strain energy? What do you mean by resilience?  
b) A cantilever beam AB of length 3.5 m is fixed at the end A and a load of 10 KN is acting at the free end B vertically downwards. Vertically downwards forces 20 KN each are acting at two points C & D in between. Distance between A & B is 1 m and that between A & D is 2 m. Draw the bending moment and shear force diagram for the beam.
3. a) What is tool life? Which are the factors affecting tool life?  
b) Discuss the mechanism of chip formation.
4. With the help of a velocity diagram find the work done on blades and the blade efficiency of an impulse turbine.