

## POST GRADUATE COMMON ENTRANCE TEST - 2015

DATE & TIME	COURSE	SUBJECT								
08-08-2015 10.30 AM TO 12.30 PM	ME / M.Tech/ M.Arch / Courses Offered by VTU / UVCE / UBDTCE	MECHANICAL SCIENCES MC / IPE / IEM / AE / MSE								
MAXIMUM MARKS	TOTAL DURATION	MAXIMUM TIME FOR ANSWERING								
100	150 MINUTES	120 MINUTES								
MENTION YOUR PGCET NO.		QUESTION BOOKLET SERIAL NUMBER								
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		VERSION CODE								
		A - 1								

### DOs :

1. Check whether the PGCET No. has been entered and shaded in the respective circles on the OMR answer sheet.
2. Ensure whether the circles corresponding to course and the specific branch have been shaded on the OMR answer sheet.
3. This question booklet is issued to you by the invigilator after the **2nd bell i.e., after 10.25 am.**
4. The serial number of this question booklet should be entered on the OMR answer sheet.
5. The version code of this question booklet should be entered on the OMR answer sheet and the respective circles should also be shaded completely.
6. Compulsorily sign at the bottom portion of the OMR answer sheet in the space provided.

### DON'Ts:

1. **THE TIMING AND MARKS PRINTED ON THE OMR ANSWER SHEET SHOULD NOT BE DAMAGED / MUTILATED / SPOILED.**
2. **THE 3RD BELL RINGS AT 10.30 AM, TILL THEN;**
  - Do not remove the seal / staple present on the right hand side of this question booklet.
  - Do not look inside this question booklet.
  - Do not start answering on the OMR answer sheet.

### IMPORTANT INSTRUCTIONS TO CANDIDATES

1. This question booklet contains 75 (items) questions and each question will have one statement and four answers. (Four different options / responses.)
2. After the 3rd Bell is rung at 10.30 am, remove the seal / staple stapled on the right hand side of this question booklet and check that this booklet does not have any unprinted or torn or missing pages or items etc., if so, get it replaced by a complete test booklet. Read each item and start answering on the OMR answer sheet.
3. During the subsequent 120 minutes:
  - Read each question (item) carefully.
  - Choose one correct answer from out of the four available responses (options / choices) given under each question / item. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **only one response** for each item.
  - Completely **darken / shade the relevant circle with a blue or black ink ballpoint pen against the question number on the OMR answer sheet.**
4. Use the space provided on each page of the question booklet for Rough Work. Do not use the OMR answer sheet for the same.
5. After the **last bell is rung at 12.30 pm**, stop marking on the OMR answer sheet and affix your left hand thumb impression on the OMR answer sheet as per the instructions.
6. Hand over the **OMR answer sheet** to the room invigilator as it is.
7. After separating the top sheet (KEA copy), the invigilator will return the bottom sheet replica (candidate's copy) to you to carry home for self evaluation.
8. Preserve the replica of the OMR answer sheet for a minimum period of ONE year.
9. Only **Non-programmable** calculators are allowed.

### MARKS DISTRIBUTION

PART - A : (SECTION - 1) 30 QUESTIONS : 30 X 1 = 30; (SECTION - 2) 15 QUESTIONS : 15 X 2 = 30  
 PART - B : (SECTION - 1) 20 QUESTIONS : 20 X 1 = 20; (SECTION - 2) 10 QUESTIONS : 10 X 2 = 20

SEAL

## MECHANICAL SCIENCE

### IMPORTANT INSTRUCTIONS & BRANCHWISE INDEX FOR THE CANDIDATES

Question Nos. 1 to 45 compulsory and common to all the branches. Question Nos. 46 to 75 are optional. sub-branches are there in this booklet. The candidate has to opt for any one branch according to his / her Application Form.

Sub - Branch	Subject	Subject	
		From	To
1.	Automobile Engineering (AE)	8	12
2.	Mechanical Engineering (MC)	13	15
3.	Industrial and Production Engineering (IPE)	16	19
4.	Industrial Engineering and Management (IEM)	20	22
5.	Manufacturing Science and Engineering (MSE)	23	27

**MECHANICAL SCIENCES**  
**COMMON TO AE/MC/IPE/IEM/MSE**  
**PART - A (SECTION - I)**  
 (Each question carries one mark)

**(30 X 1 = 30)**

1. For what values of  $h$ , the following system is consistent

$$\begin{aligned} x - 3y &= h \\ -2x + 6y &= 5 \end{aligned}$$

- a)  $h = 0$                       b)  $h = -5/2$   
 c)  $h = -5$                      d)  $h = 5/2$

2. The eigen values of the matrix  $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 2 \\ 2 & 1 & 0 \end{bmatrix}$  are

- a) 0, -1, 2                      b) -1, 0, 1  
 c) 0, 1, 2                        d) None

3. The rank of the matrix will depend on

- a) Number of rows of a matrix  
 b) Determinant of a matrix  
 c) Number of non-zero rows of a matrix  
 d) None

4. Gauss - Jordan and Gauss - elimination methods are

- a) Step by step methods  
 b) Analytical methods  
 c) Self correcting methods  
 d) Iterative methods

5. The ability of a material to resist fracture due to high impact loads, is called

- a) Strength                      b) Stiffness  
 c) Toughness                    d) Brittleness

6. In low carbon steels, presence of small quantities of sulphur improves

- a) Weldability  
 b) Formability  
 c) Mechinability  
 d) Hardenability

7. 18/8 stainless steel consists of

- a) 18% nickel and 8% chromium  
 b) 18% chromium and 8% Nickel  
 c) 18% nickel and 18% chromium  
 d) 8% nickel and 8% chromium

8. Mass moment of inertia of a uniform thin rod of mass "M" and length "l" about its mid-point and perpendicular to its length is

- a)  $\frac{2}{3} Ml^2$                       b)  $\frac{1}{3} Ml^2$   
 c)  $\frac{3}{4} Ml^2$                       d)  $\frac{4}{3} Ml^2$

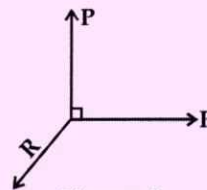


Figure - 9

- 9.

Figure 9 shows the two equal forces at right angles acting at a point. The value of force R acting along their bisector and in opposite direction is

- a)  $P/2$                               b)  $2P$   
 c)  $\sqrt{2}P$                             d)  $P/\sqrt{2}$

**Space For Rough Work**

10. In a biaxial stress problem, the stresses in x - and y - directions are  $\sigma_x = 200$  MPa,  $\sigma_y = 100$  MPa. The maximum principal stress in MPa is
- a) 50                      b) 100  
c) 150                     d) 200
11. the second moment of a circular area about the diameter is given by (D is the diameter)
- a)  $\frac{\pi D^4}{4}$                       b)  $\frac{\pi D^4}{16}$   
c)  $\frac{\pi D^4}{32}$                      d)  $\frac{\pi D^4}{64}$
12. The relationship between Young's modulus (E) Bulk modulus (K) and Poisson's ratio ( $\gamma$ ) is given by
- a)  $E = 3K(1 - 2\gamma)$   
b)  $K = 3E(1 - 2\gamma)$   
c)  $E = 3K(1 - \gamma)$   
d)  $K = 3E(1 - \gamma)$
13. A vessel of  $4\text{m}^3$  contains an oil which weighs 30 KN. The specific weight of oil is
- a)  $4.5 \text{ KN/m}^3$             b)  $6 \text{ KN/m}^3$   
c)  $7.5 \text{ KN/m}^3$             d)  $10 \text{ KN/m}^3$
14. The pressure at a point 4m below the free surface of water is
- a) 19.24 kPa              b) 29.24 kPa  
c) 39.24 kPa              d) 49.24 kPa
15. Bernoulli's equation is applied to
- a) Venturimeter  
b) Orificemeter  
c) Pitot tube  
d) All of the above
16. Which of the following is an intensive property of a thermodynamic system?
- a) Volume                      b) Temperature  
c) Mass                         d) Energy
17. The sum of internal energy (U) and the product of pressure and volume (p, v) is known as
- a) Work done                 b) Entropy  
c) Enthalpy                    d) None of these
18. The gas constant (R) is equal to the
- a) Sum of two specific heats  
b) Difference of two specific heats  
c) Product of two specific heats  
d) Ratio of two specific heats.
19. In a kinematic chain, a quaternary joint is equivalent to
- a) One binary joint  
b) two binary joint  
c) Three binary joint  
d) Four binary joint
20. In vibration isolation system, if  $\omega/\omega_n > 1$ , then the phase difference between the transmitted force and the disturbing force is
- a)  $0^\circ$                          b)  $90^\circ$   
c)  $180^\circ$                       d)  $270^\circ$

**Space For Rough Work**

21. The temperature at which the new grains are formed in the metal is called
- Lower critical temperature
  - Recrystallisation temperature
  - Upper critical temperature
  - Eutectic temperature
22. The sand used for making cores is
- green sand
  - Oil sand
  - Loam sand
  - Dry sand
23. Seam welding is a
- Process of used for joining round bars
  - Multi-spot welding process
  - Continuous spot welding
  - Arc welding process
24. The drill spindles are provided with standard taper known as
- Morse taper
  - Chapman taper
  - Sellers taper
  - Brown and sharp taper
25. Which of the following property is desirable in parts subjected to shock and impact loads?
- Strength
  - Stiffness
  - Toughness
  - Brittleness
26. Which of the following welded joint is designed for shear strength?
- Transverse fillet welded joint
  - Parallel fillet welded joint
  - Buff welded joint
  - All of these
27. The resilience of a bolt may be increased by
- increasing its shank diameter
  - increasing its length
  - decreasing its shank diameter
  - decreasing its length
28. When a shaft is subjected to combined twisting moment (T) and bending moment (M) then the equivalent bending moment is equal to
- $\frac{1}{2}\sqrt{M^2+T^2}$
  - $\sqrt{M^2+T^2}$
  - $\frac{1}{2}(M+\sqrt{M^2+T^2})$
  - $M+\sqrt{M^2+T^2}$
29. Work study involves
- Method study and work measurement
  - Only work measurement
  - Only method study
  - Only motion study
30. CPM requires
- Single time estimate
  - Double time estimate
  - Triple time estimate
  - None of these

**Space For Rough Work**

**PART - A (SECTION -II)**

(Each question carries two marks)

**(15 X 2 = 30)**

31. The two links OA and OB are connected by a pin joint at O. If the link OA turns with angular velocity 4 rad/s in the clockwise direction and the link OB turns with angular velocity 2 rad/s in the anticlockwise direction, then the rubbing velocity at the pin joint O is

- a) 8r                      b) 2r  
c) 6r                      d) 4r

where r = Radius of the pin at O

32. There are six gears A, B, C, D, E and F in a compound train. The number of teeth in the gears are 20, 60, 30, 80, 25 and 75 respectively. The ratio of angular speeds of the driven (F) to the driver (A) of the drive is

- a) 1/24                    b) 1/8  
c) 4/15                    d) 12

33. A shaft of mass ( $m_c$ ) and stiffness (S) is fixed at one end and carries a mass (m) at the other end. The natural frequency of the longitudinal vibration is equal to

- a)  $2\pi \sqrt{\frac{S}{m+m_c}}$   
b)  $2\pi \sqrt{\frac{S}{m+m_c/3}}$   
c)  $\frac{1}{2\pi} \sqrt{\frac{S}{m+m_c}}$   
d)  $\frac{1}{2\pi} \sqrt{\frac{S}{m+m_c/3}}$

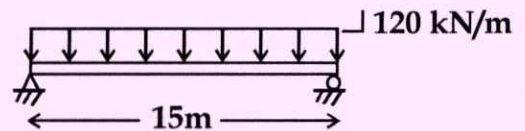
34. A solid circular shaft of 60 mm diameter transmits a torque of 1600 N-m. The value of maximum shear stress developed is

- a) 37.72 MPa              b) 47.72 MPa  
c) 57.72 MPa              d) 67.72 MPa

35. A steel bar of 40mm x 40mm square cross-section is subjected to an axial compressive load of 200 KN. If the length of the bar is 2m and  $E = 200$  GPa, the compression of the bar will be

- a) 1.25 mm                b) 2.70 mm  
c) 4.05 mm                d) 5.40 mm

36. A steel beam of breadth 120mm and height 750 mm is loaded as shown in figure. Assume  $E_{\text{steel}} = 200$  GPa. The beam is subjected to a maximum bending moment of



- a) 4750 KN - m  
b) 3375 KN - m  
c) 6750 KN - m  
d) 8750 KN - m

37. An oil of kinematic viscosity 0.4 stoke flows through a pipe of diameter 300 mm at the rate of 300 lps. The value of Reynolds number is

- a)  $3.18 \times 10^4$             b)  $31.8 \times 10^4$   
c)  $318 \times 10^4$             d)  $0.318 \times 10^4$

**Space For Rough Work**

38. The diameters of a pipe at the sections 1 and 2 are 10cm and 15cm respectively. Velocity of water at section 1 is 5 m/s. The velocity at section 2 is
- a) 3.33 m/s      b) 2.22 m/s  
c) 4.44 m/s      d) 1.11 m/s
39. The dimension of the physical quantity torque is
- a)  $ML^2T^{-2}$       b)  $M^2LT^{-2}$   
c)  $MLT^{-3}$       d)  $ML^3T^{-3}$
40. If the value for  $n = 0$  in the equation  $pv^n = c$ , then the process is called
- a) Isobaric process  
b) Adiabatic process  
c) Isochoric process  
d) Isothermal process
41. Otto cycle is also known as
- a) Constant pressure cycle  
b) Constant volume cycle  
c) Constant temperature cycle  
d) Constant temperature and pressure cycle
42. Two helical tensile springs of the same material and also having identical mean coil diameter and weight, have wire diameters  $d$  and  $d/2$ . The ratio of their stiffness constants is
- a) 16      b) 4  
c) 64      d) 128
43. The number of teeth on pinion and gear are 15 and 45 respectively. If the module of the gear is 8, then centre distance between the shaft is
- a) 360 mm      b) 480 mm  
c) 240 mm      d) 120 mm
44. A bearing is designated by the number 405, it means that a bearing is of
- a) Light series with bore of 5 mm  
b) heavy series with bore of 25 mm  
c) medium series with bore of 15 mm  
d) light series with width of 20 mm
45. If  $F$  is the fixed cost,  $V$  is the variable cost per unit (or total variable cost) and  $P$  is the selling price of each unit (or total sales value), then break-even point is equal to
- a)  $\frac{FXV}{P}$       b)  $\frac{FXP}{V}$   
c)  $\frac{F}{H(V/P)}$       d)  $\frac{F}{1-(V/P)}$

**Space For Rough Work**

**(AE : AUTOMOBILE ENGINEERING)**

**PART - B (SECTION - I)**

(Each question carries one mark)

**(20 X 1 = 20)**

- |   |  |
|---|--|
| 46. The rolling resistance is because of the friction between the                   | 49. If clearance volume of I.C. engines is increased, the compression ratio will |
| a) Wheel rim and type   | a) increase  |
| b) Tyre and the road surface  | b) decrease  |
| c) Wheel rim and road surface   | c) remain constant   |
| d) None of these  | d) be doubled  |
| 47. The torque available at the contact between driving wheels and road is known as | 50. The acid used in automobile battery is                                       |
| a) Brake effort   | a) hydrochloric acid   |
| b) Clutch effort  | b) hydrofluoric acid   |
| c) Tractive effort  | c) nitric acid   |
| d) None of these  | d) sulphuric acid  |
| 48. For the same maximum pressure and temperature                                   | 51. The function of an alternator in an automobile is to                         |
| a) Diesel cycle is more efficient than otto cycle                                   | a) Supply electric power   |
| b) Otto cycle is more efficient than diesel cycle                                   | b) Convert mechanical energy into electrical energy                              |
| c) Both otto cycle and Diesel cycle are equally efficient                           | c) Continually recharge the battery  |
| d) None of the above  | d) Partly convert engine power into electric power                               |

**Space For Rough Work**



52. When there is a reduction in amplitude over every cycle of vibration, then the body is said to have
- Free vibration
  - Forced vibration
  - Damped vibration
  - None of the above
53. The factor which affects the critical speed of a shaft is
- Diameter of the disc
  - Span of the shaft
  - Eccentricity
  - All of these
54. The ratio of the maximum displacement of the forced vibration to the deflection due to the static force, is known as
- damping factor
  - damping coefficient
  - logarithmic decrement
  - magnification factor
55. In designing a connecting rod, it is considered like ..... for buckling about x - axis.
- Both ends fixed
  - Both ends hinged
  - One end is fixed and the other end hinged
  - One end fixed and the other end free
56. For high speed engines, a rocker arm of ..... should be used
- I - Section
  - Rectangular section
  - T - Section
  - Circular
57. The skirt of piston
- is used to withstand the pressure of gas in the cylinder
  - acts as a bearing for the side thrust of the connecting rod.
  - is used to seal the cylinder in order to prevent leakage of the gas past the piston
  - None of the above
58. Lewis equation in spur gears is applied
- Only to the pinion
  - Only to the gear
  - To stronger of the pinion or gear
  - To weaker of the pinion or gear
59. The overdrive consists of ..... gear train
- Simple
  - Compound
  - Epicyclic
  - Reverted

**Space For Rough Work**

60. The type of fit that occurs when two tolerated mating parts are sometimes an interference fit and sometimes a clearance fit when assembled
- Interference fit
  - Clearance fit
  - Transition fit
  - Geometric fit
61. A hole is dimension  $\phi g^{+0.015}_{+0}$  mm. The corresponding shaft is of dimension  $\phi g^{+0.010}_{+0.001}$  mm. The resulting assembly has
- Loose running fit
  - Close running fit
  - Transition fit
  - Interference fit
62. A CNC vertical milling machine has to cut a straight slot of 10 mm width and 2mm depth by a cutter of 10mm diameter between points (0,0) and (100, 100) on the xy plane (dimensions in mm). The feed rate used for milling is 50mm/min milling time for the slot (in seconds) is
- 120
  - 170
  - 180
  - 240
63. The crank radius of a single - cylinder I.C. engine is 60mm and the diameter of the cylinder is 80mm. The swept volume of the cylinder in  $\text{cm}^3$  is
- 48
  - 96
  - 302
  - 603
64. The function of interpolater in a CNC machine controller is to
- Control spindle speed
  - Coordinate feed rates of axes
  - Control tool rapid approach speed
  - Perform miscellaneous (M) functions (tool change, coolant control etc.)
65. The centre distance between two meshing involute gears are equal to
- $\frac{\text{Sum of base circle radii}}{\cos \phi}$
  - $\frac{\text{Difference of base circle radii}}{\cos \phi}$
  - $\frac{\text{Sum of pitch circle radii}}{\cos \phi}$
  - $\frac{\text{Difference of pitch circle radii}}{\cos \phi}$

**Space For Rough Work**

**PART - B (SECTION -II)**

(Each question carries two marks)

**(10 X 2 = 20)**

66. The coefficient of rolling resistance for a truck weighing 63500 N is 0.018. The rolling resistance to the truck is

- a) 1.143 N                      b) 11.43N  
c) 114.3N                      d) 1143N

67. A petrol engine of a car develops 125 N-m torque at 2700 rpm. The car is driven in second gear having gear ratio of 1.75. The final drive ratio is 4.11. If the overall transmission efficiency is 90%. then the torque available at the driving wheels is

- a) 8.091 N -m                      b) 80.91 N-m  
c) 809.1 N-m                      d) 8091 N-m

68. For a spring -mass system as shown in figure

(i) the frequency of vibration is  $f_n$ . When one more similar spring is added in series as shown in figure (ii) the frequency of vibration will be

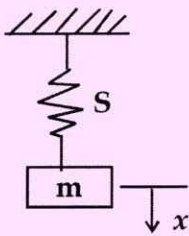


Fig (i)

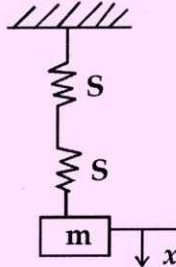


Fig (ii)

- a)  $f_n/\sqrt{2}$                       b)  $f_n$   
c)  $\sqrt{2} \cdot f_n$                       d)  $2f_n$

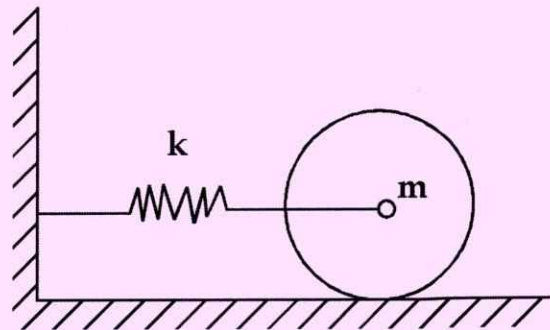
69. The equation of motion for a single degree of freedom system with viscous damping is

$$4 \frac{d^2x}{dt^2} + 9 \frac{dx}{dt} + 16x = 0$$

. The damping ratio of the system is

- a) 9/8                                      b)  $9/8\sqrt{2}$   
c) 9/16                                      d) 9/128

70. A disc of mass  $m$  is attached to a spring of stiffness  $k$  as shown in the figure. The disc rolls without slipping on a horizontal surface. The natural frequency of vibration of the system is



- a)  $\frac{1}{2\pi} \sqrt{\frac{K}{m}}$                       b)  $\frac{1}{2\pi} \sqrt{\frac{2K}{m}}$   
c)  $\frac{1}{2\pi} \sqrt{\frac{2K}{3m}}$                       d)  $\frac{1}{2\pi} \sqrt{\frac{3K}{2m}}$

**Space For Rough Work**

71. Cylindrical pins of  $25^{+0.020}_{+0.010}$  mm diameter are electroplated in a shop. Thickness of the plating is  $30^{+2.0}$  micron. Neglecting gage tolerances, the size of the GO gage in mm to inspect the plated component is

- a) 25.042
- b) 25.052
- c) 25.074
- d) 25.084

72. A triangular facet in a CAD model has vertices :  $P_1(0, 0, 0)$ ,  $P_2(1, 1, 0)$  and  $P_3(1, 1, 1)$  The area of facet is

- a) 0.500
- b) 0.707
- c) 1.414
- d) 1.732

73. Allowance in limits and fits refers to

- a) Maximum clearance between shaft and hole
- b) Minimum clearance between shaft and hole
- c) Difference between maximum and minimum size of hole
- d) Difference between maximum and minimum size of shaft

74. The tool of an NC machine has to move along a circular arc from (5, 5) to (10, 10) while performing an operation. The centre of the arc is at (10, 5). Which one of the following NC tool path commands performs the above mentioned operation?

- a) N010 G01 X10 Y10 X5 Y5 R5
- b) N010 G03 X10 Y10 X5 Y5 R5
- c) N010 G01 X5 Y5 X10 Y10 R5
- d) N010 G02 X5 Y5 X10 Y10 R5

75. The firing order for an in-line four cylinder I.C. engine is

- a) 1 - 3 - 2 - u
- b) 1 - 3 - 4 - 2
- c) 1 - 2 - u - 3
- d) 1 - 2 - 3 - u

**Space For Rough Work**

( MC: MECHANICAL ENGINEERING )

PART - B (SECTION - I)

(Each question carries one mark)

(20 X 1 = 20)

46. For a given heat flow and for the same thickness the temperature drop across the material will be maximum for
- Copper
  - Steel
  - Glass-wool
  - Refractory circle
47. In case of one dimensional heat conduction in a medium with constant properties, T is the temperature at position, X at time t, then  $\frac{\partial T}{\partial t}$  is proportional to
- $\frac{T}{X}$
  - $\frac{\partial T}{\partial x}$
  - $\frac{\partial^2 t}{\partial x \partial t}$
  - $\frac{\partial^2 T}{\partial x^2}$
48. For the same inlet and outlet temperature of hot and cold fluids, the Log Mean Temperature Difference (LMTD) is
- Greater for parallel flow
  - Greater for counter flow
  - Same for both
  - Dependent on the properties of fluids
49. In a pulverized - fuel - fired large power boiler the heat transfer from the burning fuel to the wall of the furnace is
- by conduction only
  - by convection only
  - by conduction and convection
  - Predominantly by radiation
50. Cavitation in a hydraulic turbine is most likely to occur at the turbine
- Entry
  - Exit
  - Stator exit
  - Rotor exit
51. Streamlines, pathlines, streak lines are virtually identical for
- Uniform flow
  - Flow of ideal fluids
  - Steady flow
  - Non-uniform flow
52. A fluid is said to be Newtonian when the shear stress is
- Directly proportional to velocity gradient
  - Inversely proportional to velocity gradient
  - Independent of velocity gradient
  - None of these
53. In flow through a pipe, the transition from laminar to turbulent flow does not depend on
- Velocity of the fluid
  - Density of the fluid
  - Diameter of the pipe
  - Length of the pipe
54. Kaplan turbine is
- A high head mixed flow turbine
  - A low axial flow turbine
  - An outward flow reaction turbine
  - An Impulse inward flow turbine

Space For Rough Work

55. In PERT, the distribution of activity times is assumed to be
- a) Normal
  - b) Gamma
  - c) Beta
  - d) Exponential
56. The most commonly used criteria for measuring forecast error is
- a) Mean absolute deviations
  - b) Mean absolute percentage error
  - c) Mean standard error
  - d) Mean square error
57. Auto Collimator is used to check
- a) Roughness
  - b) Flatness
  - c) Angle
  - d) Automobile balance
58. Which one of the following forecasting technique is not suited for making forecasts for planning production schedules in the short range
- a) Moving average
  - b) Exponential moving average
  - c) Regression analysis
  - d) Delphi
59. In order to have interference fit, it is essential that the lower limit of the shaft should be
- a) Greater than the upper limit of the hole
  - b) Lesser than the upper limit of the hole
  - c) Greater than the lower limit of the hole
  - d) Lesser than the lower limit of the hole.
60. Operation management is a \_\_\_\_\_ process
- a) Translation
  - b) Transformation
  - c) Transaction
  - d) Transition
61. Which of these would an operations manager not be responsible for
- a) Safety and maintenance
  - b) Sales and marketing
  - c) Selecting supplier
  - d) Recruiting employees
62. Transducers produce output voltage in the form of
- a) an analog voltage in the form of current
  - b) an analog voltage in the form of voltage
  - c) an analog voltage in the form of pressure
  - d) all of the above
63. What is signal conditioning
- a) To analyse any signal
  - b) Conversion or modification of signal
  - c) Conversion of analog to digital signal
  - d) Conversion of digital to analog signal
64. NC contouring is an example of
- a) Continuous path positioning
  - b) Point to point positioning
  - c) Absolute positioning
  - d) Incremental positioning.
65. In the following geometric modelling technique which are not 3-D modelling
- a) Wireframe modelling
  - b) Drafting
  - c) Surface modelling
  - d) Solid modelling

**Space For Rough Work**

**PART - B (SECTION -II)**

(Each question carries two marks)

**(10 X 2 = 20)**

66. A turbine develops 9000 kW when running at 100rpm head on turbine is 30m. If head on the turbine is reduced to 18m, the power developed by turbine is
- a) 4182.84 kW                      b) 3228.48 kW  
c) 2182.48 kW                      d) 2382.84 kW
67. A turbine operates under a head of 25m at 200 rpm, Discharge is 9 m<sup>3</sup>/s, overall efficiency is 90% power developed is
- a) 1986.5 kW                      b) 2986.5 kW  
c) 986.5 kW                      d) 3986.5 kW
68. Pelton wheel develops 2000 kW under a head of 100 m and with an overall efficiency of 85% the discharge is
- a) 0.4 m<sup>3</sup>/s                      b) 2.4 m<sup>3</sup>/s  
c) 1.4 m<sup>3</sup>/s                      d) 3.4 m<sup>3</sup>/s
69. An electric cable of aluminium conductor (K=240w/mk) is to be insulated with rubber (K=0.15w/mk). The cable is to be located in air (h=6w/m<sup>2</sup>). the critical thickness insulation will be
- a) 25mm                      b) 40mm  
c) 160mm                      d) 800mm
70. When  $t_{c1}$  and  $t_{c2}$  are the temperature of cold fluid at entry and exit respectively and  $t_{h1}$  and  $t_{h2}$  are the temperature of hot fluid at entry and exit point and cold fluid has lower heat capacity rate as compared to hot fluid, then effectiveness of the heat exchanger is given by
- a)  $\frac{t_{c1} - t_{c2}}{t_{h1} - t_{c1}}$                       b)  $\frac{t_{h2} - t_{h1}}{t_{c1} - t_{h1}}$   
c)  $\frac{t_{h1} - t_{h2}}{t_{h1} - t_{c1}}$                       d)  $\frac{t_{c2} - t_{c1}}{t_{h1} - t_{c1}}$
71. In a forecasting model, at the end of the period 13, the forecasted value for period 14 is 75. Actual value in the periods 14 to 16 are constant at 100. If the assumed simple exponential smoothing parameter is 0.5, then the MSE at the end of period 16 is
- a) 820.31                      b) 273.44  
c) 43.75                      d) 14.58
72. In computing Wilson's economic lot size for an item, by mistake the demand rate estimate used was 40% higher than the true demand rate. Due to this error in the lot size computation, the total cost of setups plus inventory holding per unit time, would rise above the true optimum by approximately
- a) 1.4%                      b) 6.3%  
c) 18.3%                      d) 8.7%
73. A manufacturer produces two types of products 1 and 2, at production levels of  $x_1$  and  $x_2$  respectively. The profits is given by  $2x_1 + 5x_2$ . The production constraints are
- $$x_1 + 3x_2 \leq 40$$
- $$3x_1 + x_2 \leq 24$$
- $$x_1 + x_2 \leq 10$$
- $x_1 > 0, x_2 > 0$  the maximum profit which can meet the constraints is
- a) 29    b) 38    c) 44    d) 75
74. A fit is specified as 25 H8/e8. The tolerance value for a nominal diameter of 25 mm in IT8 is 33 microns and fundamental deviation for the shaft is - 40 microns, the maximum clearance of the fit in micron is
- a) -7    b) 7    c) 73    d) 106
75. Match the following configuration of robot
- |                |                         |
|----------------|-------------------------|
| P. Cartesian   | $1 \alpha \beta \gamma$ |
| Q. Cylindrical | $2 x y Z$               |
| R. Articulated | $3 x y \theta$          |
- where  $x y z$  linear co-ordinate and rest are angular
- a) P-2, Q-3, R-1                      b) P-1, Q-2, R-3  
c) P-3, Q-2, R-1                      d) None of these

**Space For Rough Work**

# IPE - INDUSTRIAL AND PRODUCTION ENGINEERING

## PART - B (SECTION - I)

(Each question carries one mark)

(20 X 1 = 20)

46. The gauge used to check the clearance between two mating parts
- a) Screw gauge    b) Radius gauge  
c) Feeler gauge    d) Wire gauge
47. The straight surface between the crest and root of the thread is called
- a) Flank            b) Lead  
c) Pitch            d) None
48. Diameter of the best size wire  $D_b$  is
- a)  $\frac{P}{2} \cos \phi$                       b)  $\frac{P}{2} \sec \phi$   
c)  $\frac{P^2}{2} \sin \phi$                       d) None
49. A feasible solution requires that all artificial variable is
- a) Greater than zero  
b) Less than zero  
c) Equal to zero  
d) None of these
50. Which type of control chart should be used when it is possible to have more than one mistake per item
- a) X-bar chart    b) C-chart  
c) R - chart        d) P - chart
51. In acceptance sampling the producer risk is the risk of having a
- a) bad lot accepted  
b) good lot rejected  
c) bad lot rejected  
d) good lot accepted
52. For the last 30 days, the number of mistakes on the daily report has averaged 4.5. What would the UCL be if a 3-sigma C-chart was constructed
- a) 18                      b) 10.86  
c) 7.5                     d) 2.12
53. Calculating the time required to do a job so that one can then work out how many people are required is termed
- a) Method study  
b) Ergonomics  
c) Work measurement  
d) Technology study
54. The process of allocating a large number of tasks to individual is called
- a) Job empowerment  
b) Job enlargement  
c) Job enrichment  
d) Job rotation

Space For Rough Work



55. The computerised technology that is used to design part is known as
- a) CIM                      b) CAM  
c) CAD                      d) All of these
56. Which of the following are true about numerically controlled machines
- a) NC machines are pre-programmed to drill, turn, mill  
b) NC machines are the most commonly used form of flexible automation  
c) a) and b)  
d) None of the above
57. An industrial robot end effector can be changed to perform different task, including which of the following
- a) Spot welding  
b) Spray painting  
c) Material handling  
d) All of the above
58. Which of the following probes is most commonly used for testing welded metals for laminations before angle beam inspection
- a) Surface wave probe  
b) Twin crystal 0° probe  
c) Single crystal probe  
d) An angle probe
59. Sound can propagate as
- a) Longitudinal wave  
b) Shear waves  
c) Surface waves  
d) All of these
60. TIG welding is also known as
- a) Metal inert gas welding  
b) Torch inert gas welding  
c) Gas shielded metal arc welding  
d) Tungsten inert gas welding
61. An ultrasonic testing technique in which the transducer (crystal) is at an angle to the test surface is called
- a) Angle beam testing  
b) Immersion testing  
c) Contact testing  
d) Through-transmission testing
62. Which of the following media has the lowest velocity of ultrasound
- a) Water                      b) Plastic  
c) Air                          d) Steel
63. Which machining process are used for gear manufacture
1. Form milling      2. Broaching  
3. Roll forming      4. Hobbing
- Select correct answer using the code given below
- a. 1, 2 & 3                  b. 1, 3 & 4  
c. 1, 2 & 4                  d. 2, 3 & 4
64. Flank wear occurs mainly on which of the following
- a) Nose part & top face  
b) Wearing edge only  
c) Nose part, front relief face & side relief face of cutting edge  
d) Face of the tooling edge
65. The casting materials for coated carbide tool include
- a) Tic, Tin and NaCN  
b) Tic & Tin  
c) Tin and NaCN  
d) Tic and NaCN

**Space For Rough Work**

**PART - B (SECTION -II)**

(Each question carries two marks)

**(10 X 2 = 20)**

66. A medium carbon steel work piece is turned on a lathe of 50m/min tooling speed, 0.8mm/rev feed and 1.5 mm depth of cut. What is the value of material removal rate
- a) 1000 mm<sup>2</sup>/min
  - b) 60,000 mm<sup>3</sup>/min
  - c) 20,000 mm<sup>3</sup>/min
  - d) Cannot be calculated with the given data
67. The rake angle of a cutting edge is 15° shear angle 45° and tooling velocity 35m/min. What is the velocity of chip along the cut face
- a) 28.5 m/min
  - b) 27.3 m/min
  - c) 25.3 m/min
  - d) 23.5 m/min
68. Consider the following statements  
A nomenclature 50 H8/P8 denotes that
- 1. Hole diameter is 50 mm
  - 2. it is a shaft base system
  - 3. 8 indicates fundamental deviation
- Which of the statement given above is/ are correct
- a) 1, 2, & 3
  - b) 1 & 2 only
  - c) 1 & 3 only
  - d) 3 only
69. Twenty samples of size 100 are taken the total number of defective item is 75. What is the UCL of the 3 sigma (Z =3) P-chart
- a) 0.094
  - b) 0.793
  - c) 0.0375
  - d) 0.165
70. A box of 1000 parts is subjected to an acceptance sampling plan that examines only 50 parts. The actual fraction defective in the box is 0.02 and the sampling plan has a 0.53 probability of accepting a box of this quality. What is average outgoing quality for the scenario
- a) 0.53
  - b) 0.02
  - c) 0.51
  - d) 0.01

**Space For Rough Work**

71. In an NC machining operation, the tool has to be moved from point (5,4) to point (7,2) along a circular path with centre at (5,2) before starting the operations. The tool is at (5,4) the correct G and M code for this motion

- a) N010 G03 X7 Y2 I5 J2
- b) N010 G02 X7 Y2 I5 J2
- c) N010 G01 X7 Y2 I5 J2
- d) N010 G00 X7 Y2 I5 J2

72. The fluorescent dyes used in the liquid penetrant testing process are most active when energised with black light of what wave length? ( $\text{\AA}$  stands for angstrom units)

- a) 2000  $\text{\AA}$
- b) 2500  $\text{\AA}$
- c) 3250  $\text{\AA}$
- d) 3650  $\text{\AA}$

73. What is the magnetic field strength at the surface of a 100 mm diameter bar as compared to that at the surface of a 50mm diameter bar, each carrying 1000 amps of current

- a) Twice
- b) One half
- c) One quarter
- d) Four times

74. Consider the following linear programming problem

$$\text{maximize } Z = 3x_1 + 2x_2$$

subject to

$$x_1 \leq 4$$

$$x_2 \leq 6$$

$$3x_1 + 2x_2 \leq 18$$

$$x_1 \geq 0, x_2 \geq 0$$

- a) The LPP has a unique optimal solution
- b) The LPP is infeasible
- c) The LPP is unbounded
- d) The LPP has multiple optimal solution

75. A manufacture produces two types of products 1 and 2, at production level of  $x_1$  and  $x_2$  respectively. The profit is given is  $2x_1 + 5x_2$ . The production constraints are :

$$x_1 + 3x_2 \leq 40, 3x_1 + x_2 \leq 24,$$

$$x_1 + x_2 \leq 10, x_1 > 0, x_2 > 0$$

the maximum profit which can meet the constraints is

- a) 29
- b) 38
- c) 44
- d) 75

**Space For Rough Work**

**IEM: INDUSTRIAL ENGINEERING AND MANAGEMENT**

**PART - B (SECTION - I)**

(Each question carries one mark)

**(20 X 1 = 20)**

- |   |   |
|---|---|
| <p>46. Ergonomics has evolved to be concerned with</p> <ul style="list-style-type: none"><li>a) Design of work equipment</li><li>b) Adapting the person to the workplace</li><li>c) Design and development of equipment</li><li>d) Design of whole systems of work</li></ul> <p>47. Who is known as “the father of scientific management”?</p> <ul style="list-style-type: none"><li>a) Fredrick W. Taylor</li><li>b) Henry Fayol</li><li>c) Robert Owen</li><li>d) Non of these</li></ul> <p>48. Forces affecting organisational behaviour are</p> <ul style="list-style-type: none"><li>a) People                      b) Environment</li><li>c) Technology                d) All of the above</li></ul> <p>49. Who is recognised as “father of human relations” ?</p> <ul style="list-style-type: none"><li>a) William Gilbreth</li><li>b) Hendry Fayol</li><li>c) F.W. Taylor</li><li>d) Elton Mayo</li></ul> <p>50. Operations Research involves _____ attack of complex problems to arrive at the optimum solution</p> <ul style="list-style-type: none"><li>a) Scientific</li><li>b) Systematic</li><li>c) Both “a” and “b”</li><li>d) Statistical</li></ul> | <p>51. In LPP, degeneracy occurs in _____ stages</p> <ul style="list-style-type: none"><li>a) One                              b) Two</li><li>c) Three                            d) Four</li></ul> <p>52. A given transportation problem is said to be unbalanced, if the total supply is not equal to the total</p> <ul style="list-style-type: none"><li>a) Optimisation</li><li>b) Demand</li><li>c) Cost</li><li>d) None of the above</li></ul> <p>53. Logistics is the part of a supply chain involved with the forward and reverse flow of</p> <ul style="list-style-type: none"><li>a) Goods                            b) Services</li><li>c) Cash                              d) All of the above</li></ul> <p>54. The first activity of purchasing cycle is</p> <ul style="list-style-type: none"><li>a) Communicating requirement to the purchase</li><li>b) Source selection and development</li><li>c) Recognising the need for procurement</li><li>d) Inspection of goods</li></ul> <p>55. The difference between the maximum limit of size and minimum limit of size is called</p> <ul style="list-style-type: none"><li>a) Size tolerance</li><li>b) Tolerance Zone</li><li>c) Standard tolerance</li><li>d) All of the above</li></ul> |
|---|---|

**Space For Rough Work**

56. In time study, the rating factor is applied to determine
- Standard time of a job
  - Merit rating of the worker
  - Fixation of incentive rate
  - Normal time of a worker
57. PERT analysis is based upon
- Optimistic time
  - Pessimistic time
  - Most likely time
  - All of these
58. A - B - C analysis is used in
- CPM
  - PERT
  - Inventory control
  - All of these
59. In order to avoid excessive multiplication of facilities, the layout preferred is
- Product layout
  - Process layout
  - Group layout
  - Static layout
60. Gantt chart is used for
- Inventory control
  - Material handling
  - Production schedule
  - Machine repair schedules
61. The factors to be considered for production scheduling are
- Component design
  - Route sheet
  - Time Standards
  - All of these
62. The computerized technology that is used to design part is known as
- CIM
  - CAM
  - CAD
  - All of these
63. Which of the following are true about numerically controlled machines?
- NC machines are pre-programmed to drill, turn, mill
  - NC machines are the most commonly used form of flexible automation
  - (a) and (b)
  - None of the above
64. Auto collimator is used to check
- Roughness
  - Flatness
  - Angle
  - Automobile balance
65. In the specification of dimensions and fits
- Allowance is equal to bilateral tolerance
  - Allowance is equal to unilateral tolerance
  - Allowance is independent of tolerance
  - Allowance is equal to the difference between maximum and minimum dimension specified by the tolerance.

**Space For Rough Work**

**PART - B (SECTION -II)**

(Each question carries two marks)

**(10 X 2 = 20)**

66. For a small scale industry, the fixed cost per month is Rs. 5,000. The variable cost per product is Rs. 20 and sales price is Rs. 30 per piece. The break-even production per month will be
- a) 300                      b) 460  
c) 500                      d) 1000
67. In CPM, the cost slope is determined by
- a)  $\frac{\text{Crash cost}}{\text{Normal cost}}$                       b)  $\frac{\text{Crash cost} - \text{Normal cost}}{\text{Normal time} - \text{crash time}}$   
c)  $\frac{\text{Normal cost}}{\text{Crash cost}}$                       d)  $\frac{\text{Normal cost} - \text{Crash cost}}{\text{Normal time} - \text{Crash time}}$
68. If A is the total items consumed per year, P is the procurement cost per order and C is the annual inventory carrying cost per item, then the most economic ordering quantity is given by
- a)  $AP/C$                       b)  $2AP/C$   
c)  $\sqrt{\frac{2AP}{C}}$                       d)  $\left(\frac{AP}{C}\right)^2$
69. The mathematical technique for finding the best use of limited resources of a company in the maximum manner is known as
- a) Value analysis  
b) Network analysis  
c) Linear programming  
d) Queing theory
70. When the dimension is expressed as  $20^{+0.035}_{-0.025}$  then the tolerance is
- a) 0.035 mm                      b) 0.025 mm  
c) 0.01 mm                      d) 0.06 mm
71. The accuracy of micrometers, calipers, dial indicators can be checked by a
- a) Feeler gauge                      b) Slip gauge  
c) Ring gauge                      d) Plug gauge
72. A company uses 2555 units of an item annually. Delivery lead time is 8 days. The recorder point (in number of units) to achieve optimum inventory is
- a) 7                                      b) 8  
c) 56                                      d) 60
73. Arrivals at a telephone booth are considered to be poisson, with an average time of 10 minutes between successive arrivals. The length of a phone call is distributed exponentially with mean 3 minutes. The probability that an arrival doesnot have to wait before service is
- a) 0.3                                      b) 0.5  
c) 0.7                                      d) 0.9
74. Vehicle manufacturing assembly line is an example of
- a) Product layout  
b) Process layout  
c) Manual layout  
d) Fixed layout
75. In a CNC program block, N002 G02 G91 X40 Z40 ....., G02 and G91 refer to
- a) Circular interpolation in CCW direction and incremental dimension  
b) Circular interpolation in CCW direction and absolute dimension  
c) Circular interpolation in clockwise direction and incremental dimension  
d) Circular interpolation in clockwise direction and absolute dimension

**Space For Rough Work**

**MSE : MANUFACTURING SCIENCE AND ENGINEERING**

**PART - B (SECTION - I)**

(Each question carries one marks)

**(20 X 1 = 20)**

46. In D.C. welding, the straight polarity (Electrode negative) results in
- a) Lower penetration
  - b) Lower deposition rate
  - c) Less heating of workpiece
  - d) Smaller weld pod
47. In oxyacetylene gas welding, temperature at the inner core of the flame is around
- a) 3500°C      b) 3200°C
  - c) 2900°C      d) 2550°C
48. In deep drawing of sheets, the value of limiting draw ratio depends on
- a) Percentage elongation of sheet metal
  - b) Yield strength of sheet metal
  - c) Type of press used
  - d) Thickness of sheet
49. Hot rolling of mild-steel carried out
- a) at re-crystalization temperature
  - b) between 100°C and 150°C
  - c) between re-crystalization temperature
  - d) Above re-crystalization temperature
50. In a point to point control NC machine, the slides are positioned by an integrally mounted stepper motor drive. If the specification of the motor is 1°/pulse, and the pitch of the lead screw is 3.6 mm, what is the expected position accuracy
- a) 1 mm      b) 10 mm
  - c) 50 mm      d) 100 mm
51. In a point to point type of NC system
- a) Control of position and velocity of the tool is essential
  - b) Control of only position of the tool is sufficient
  - c) Control of only velocity of the tool is sufficient
  - d) Neither position nor velocity need to be controlled
52. The effect of rake angle on the mean friction angle in machining can be explained by
- a) Sliding model of friction
  - b) Sticking and then sliding model of friction
  - c) Sticking friction
  - d) Sliding and then sticking model of friction

**Space For Rough Work**

53. Cutting power consumption in turning can be significantly reduced by
- a) Increasing rake angle of the tool
  - b) Increasing the cutting angle of the tool
  - c) Widening the nose radius of the tool
  - d) Increasing the clearance angle
54. A shaft (diameter  $20^{+0.05}_{-0.15}$  mm) and a hole (diameter  $20^{+0.20}_{-0.1}$  mm) when assembled would yield
- a) Transition fit
  - b) Interference fit
  - c) Clearance fit
  - d) None of these
55. The fit on a hole-shaft system is specified as 117-56. The type of fit is
- a) Clearance fit
  - b) Sliding fit
  - c) Push fit
  - d) Force fit
56. A dummy activity is used in PERT network to describe
- a) Precedence relationship
  - b) Necessary time delay
  - c) Resource restriction
  - d) Resource idleness
57. The general tools used in presses are
- a) Drill bits
  - b) Boxing tools
  - c) Dies and punches
  - d) None of these
58. Which of the following materials is an artificial abrasive
- a) Sand stone
  - b) Diamond
  - c) Emery
  - d) Silicon carbide
59. The operation of forging done in a closed impression die by means of drop hammers is called as
- a) Press forging
  - b) Drop forging
  - c) Upset forging
  - d) None of these

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**Space For Rough Work**



60. Controlling of machine tools by means of prepared program consisting of blocks or series of numbers are known as
- a) Numerical control
  - b) Automatic control
  - c) Mechanical control
  - d) None of these
61. The dimensional limits on a shaft of 2547 are
- a) 25.000, 25.021 mm
  - b) 25.000, 24.979 mm
  - c) 25.000, 25.007 mm
  - d) 25.000, 24.993 mm
62. In PERT analysis a critical activity has
- a) Maximum float
  - b) Zero float
  - c) Maximum cost
  - d) Minimum cost
63. A ring gauge is used to measure
- a) Outside diameter but not roundness
  - b) Roundness but not outside diameter
  - c) Both outside diameter and roundness
  - d) Only external threads
64. Simplex method of solving linear programming problem are
- a) All the points in the feasible region
  - b) Only the corner points of the feasible region
  - c) Intermediate points within the feasible region
  - d) Only the interior points in the feasible region
65. Which of the following is not the robot programming method
- a) Walk through method
  - b) Lead through method
  - c) Half-line programming
  - d) Transfer-line programming

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**Space For Rough Work**

**PART - B (SECTION -II)**

(Each question carries two mark)

**(10 X 2 = 20)**

66. Tool life of 10 hours is obtained when cutting with single point tool at 63m/min. If Taylors constant  $C = 257.35$ , tool life on doubling the velocity will be

- a) 5 hours                      b) 25.7 min
- c) 38.3 min                    d) Unchanged

67. In a typical metal cutting operation using a cutting tool of positive rake  $r = 10^\circ$ , it was observed that the shear angle was  $20^\circ$  the friction angle is

- a)  $45^\circ$                                       b)  $30^\circ$
- c)  $60^\circ$                                       d)  $40^\circ$

68. A brace billet is to be extruded from its initial diameter of 100mm to a final diameter of 50mm. The working temperature of  $700^\circ\text{C}$  and the extrusion constant is 250 Mpa. The force required for extrusion is

- a) 5.44 MN
- b) 2.72 MN
- c) 1.36 MN
- d) 0.36 MN

69. In a CNC program block, N02 G02 G91 X40 Z40, G02 and G91 refer to

- a) Circular interpolation in CCW and incremental dimensions
- b) Circular interpolation in CCW and absolute dimensions
- c) Circular interpolation in CW and incremental dimensions
- d) Circular interpolation in CW and absolute dimensions

70. What is the percentage increase in tool life when the cutting speed is halved

- a) 50%                                      b) 200%
- c) 300%                                    d) 400%

71. Match the following:

NC code	Definition
P.M05	1. Absolute cordination
Q.G01	2. Linear interpolation
R.G04	3. Spindle stop
S.G90	4. Linear interpolation

- a) P-2, Q-3, R-4, S-1
- b) P-3, Q-4, R-1, S-2
- c) P-3, Q-4, R-2, S-1
- d) P-4, Q-3, R-2, S-1

**Space For Rough Work**

72. In open-die forging, the disc of diameter 200mm and height 60mm is compressed without any barreling effect. The final diameter of the disc is 400mm, the true strain is

- a) 1.986
- b) 1.686
- c) 1.386
- d) 0.602

73. A project consists of three parallel paths with mean duration and variance of (10,4), (12,4) and (12,9) respectively. According to the standard PERT assumptions the distribution of project duration is

- a) Beta with mean 10 and standard deviation 2
- b) Beta with mean 12 and standard deviation 2
- c) Normal with mean 10 and standard deviation 3
- d) Normal with mean 12 and standard deviation 3

74. What are the upper and lower limits of the shaft represented by 60f8

use the following data / Diameter 60 lies in the diameter step of 50-80 mm

fundamental tolerance unit  $i$ , in  $U_m = 0.45 D^{1/3} + 0.001 D$  where  $D$  is representative size in mm. Tolerance value for IT8 =  $25i$ , fundamental deviation for  $t$  shaft =  $-5.5 D^{0.41}$

- a) lower limit = 59.924 mm,  
upper limit = 59.970 mm
- b) Lower limit = 59.954 mm,  
upper limit = 60.000 mm
- c) lower limit = 59.970 mm,  
upper limit = 60.016 mm
- d) lower limit = 60.000 mm,  
upper limit = 60.046 mm

75. The expected time ( $t_e$ ) of a PERT activity in terms of optimistic time ( $t_o$ ), pessimistic time ( $t_p$ ) and most likely time ( $t_l$ ) is given by

- a)  $t_e = \frac{t_o + 4t_l + t_p}{6}$
- b)  $t_e = \frac{t_o + 4t_p + t_l}{6}$
- c)  $t_e = \frac{t_o + 4t_l + t_p}{3}$
- d)  $t_e = \frac{t_o + 4t_l + t_l}{3}$

**Space For Rough Work**

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