6000

POST GRADUATE COMMON ENTRANCE TEST – 2011

DATE and TIME	COURSE	SUBJECT
06-08-2011 **10:30 am to 12:30 pm**	**ME / M. Tech /** **MBA (Infrastructure Management)** **courses offered by VTU / UVCE / UBDTCE**	**Mechanical Sciences** AE / MC / IPE / IEM / MSE

MAXIMUM MARKS	TOTAL DURATION	MAXIMUM TIME FOR ANSWERING
100	**150 Minutes**	**120 Minutes**

MENTION YOUR PGCET NO.					QUESTION BOOKLET DETAILS	
					VERSION CODE	SERIAL NUMBER
					A_3	00003587

DOs

1. Check whether the PGCET No. has been entered and shaded in the respective circles on the OMR answer sheet.
2. This question booklet is issued to you by the invigilator after the **2nd Bell, i.e. after 10:25 am.**
3. The serial number of this question booklet should be entered on the OMR answer sheet.
4. The version code of this question booklet should be entered on the OMR answer sheet and the respective circles should also be shaded completely.
5. 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 seals of this question booklet.
   - Do not look inside this question booklet.
   - Do not start marking 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 seals 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 marking 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 question / 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. Please note that even a minute unintended ink dot on the OMR answer sheet will also be recognized and recorded by the scanner. Therefore, avoid multiple markings of any kind on the OMR answer sheet.
5. Use the space provided at the bottom on each page of the question booklet for Rough Work. Do not use the OMR answer sheet for the same.
6. 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.
7. Hand over the **OMR answer sheet** to the room invigilator as it is.
8. 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.
9. Preserve the replica of the OMR answer sheet for a minimum period of ONE year.
10. Only **Non-programmable** calculators are allowed.
11. **Please note this Question Booklet consists of *sub*-branches. Total number of questions is 75. Question Nos. 1 to 45 is compulsory and common to all the branches. Candidate has to answer *any one* paper from Question Nos. 46 – 75 out of the *sub*-branches as opted, by him/her in the Application Form.**

Marks Distribution

PART – *A* : (Section-I) 30 Questions : 30 × 1 = 30 ; (Section-II) : 15 Questions : 15 × 2 = 30
PART – *B* : (Section-I) 20 Questions : 20 × 1 = 20 ; (Section-II) : 10 Questions : 10 × 2 = 20

[P.T.O.

SEAL

SEAL

MECHANICAL SCIENCES

IMPORTANT INSTRUCTIONS AND BRANCHWISE INDEX FOR THE CANDIDATES

Question Nos. 1 to 45 is compulsory and common to all the branches. Question Nos. 46 to are optional. Sub-branches are there in this Booklet. The candidate has to opt any one bran according to his/her Application Form.

PART – A

(Common to AE/MC/IPE/IEM/MSE)

SECTION – I

Each question carries *one* mark. $30 \times 1 = 30$

1. Nitriding is carried on which of following appropriate steels ?

   (A) Mild steel (B) Stainless steel

   (C) Nitroalloy steel (D) Austenitic steel.

2. Plastic deformation occurs by mechanisms such as

   (A) crack initiation (B) slip

   (C) twinning (D) both slip and twinning.

3. Centre of gravity of a circular segment with a height of r units and base of $2r$ units is

   (A) $\frac{2r}{3\pi}$ (B) $\frac{4r}{2\pi}$

   (C) $\frac{4r}{3\pi}$ (D) $\frac{2r}{4\pi}$.

4. Moment of inertia of rectangular section of width b and depth d is

   (A) $\frac{bd^2}{6}$ (B) $\frac{b^3 d}{12}$

   (C) $\frac{db^2}{6}$ (D) $\frac{bd^3}{12}$.

5. The statement "Amount of inertia of a rigid body about an axis is equal to sum of moments of inertia about a parallel axis passing through its centre of mass and product of mass and square of distance between two axes" relates to

   (A) First law of thermodynamics (B) Parallel axis theorem

   (C) Perpendicular axis theorem (D) Newton's first law.

6. If Reynolds number is greater than 4500, the flow is

   (A) lamellar (B) smooth

   (C) jerky (D) turbulent.

SPACE FOR ROUGH WORK

7. Condition to wet the surfaces by a liquid is

(A) $\theta > 90°$ (B) $\theta = 45°$

(C) $\theta < 90°$ (D) $\theta > 45°$.

8. $PV^n = C$, if $n = 1{\cdot}4$, the process is termed as

(A) isobaric (B) isochoric

(C) adiabatic (D) isothermal.

9. The efficiency of a Carnot engine is

(A) $\frac{T_1 - T_2}{T_1 T_2}$ (B) $\frac{T_1 T_2}{T_1 - T_2}$

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

10. Efficiency of Otto cycle is given by

(A) $\eta = 1 + \frac{1}{(r)^{r+1}}$ (B) $\eta = 2 - \frac{1}{(r)^{r-1}}$

(C) $\eta = 1 - \frac{1}{(r)^{r-1}}$ (D) $\eta = 1 - \frac{1}{(r)}$.

11. Process of making hollow castings by use of permanent moulds without use of co

(A) Die casting (B) Centrifugal casting

(C) Slush casting (D) Investment casting.

12. Orthogonal cutting system is also called

(A) 1-D cutting system (B) 2-D cutting system

(C) 3-D cutting system (D) $2\frac{1}{2}$-D cutting system.

13. In four high rolling mill, the bigger rollers are called

(A) guide rolls (B) back-up rolls

(C) support rolls (D) main rolls.

14. The term AOQL refers to

(A) bad quality (B) not acceptable

(C) average outgoing quality level (D) good quality.

SPACE FOR ROUGH WORK

15. The term CPM refers to

(A) Critical Path Method (B) Critical Parts Management

(C) Crisis Part Management (D) Critical Part Manufacturing.

16. Which one of the following statements is false ?

(A) Two matrices of same order cannot be multiplied unless they are square matrices.

(B) Values of the determinants of two identity matrices are equal.

(C) For a symmetric matrix A, $\left| A - A' \right| = |A| - \left| A' \right|$.

(D) The determinant of symmetric matrix of odd order is zero.

17. If $A = \begin{bmatrix} 4 & 0 \\ 0 & 3 \end{bmatrix}$ then A^{-2} is equal to

(A) $\frac{1}{12}\begin{bmatrix} 16 & 0 \\ 0 & 9 \end{bmatrix}$ (B) $\frac{1}{144}\begin{bmatrix} 9 & 0 \\ 0 & 16 \end{bmatrix}$

(C) $144\begin{bmatrix} 16 & 0 \\ 0 & 9 \end{bmatrix}$ (D) $12\begin{bmatrix} 9 & 0 \\ 16 & 0 \end{bmatrix}$.

18. Solution of the differential equation $\frac{dy}{dx} = e^{(x-y)}$ is

(A) 1 (B) $x - y = c$

(C) $e^{(x-y)} = c$ (D) $e^x - e^y = c$.

19. $\int \frac{\cos \sqrt{x}}{\sqrt{x}} dx$ is equal to

(A) $2 \cos \sqrt{x}$ (B) $\frac{\sqrt{\cos x}}{x}$

(C) $\sin \sqrt{x}$ (D) $2 \sin \sqrt{x}$.

20. Iron at room temperature possesses which of the following crystal lattices ?

(A) BCC (B) HCP

(C) Hexagonal (D) BCT.

SPACE FOR ROUGH WORK

21. A cantilever 1·5 m long carries a UDL over entire span. If the slope at free end is 1·5°, the deflection at free end is

(A) 26·45 (B) 32·45

(C) 29·45 (D) 31·45.

22. The central deflection of a simply supported beam of span length L and carrying a point load P at its centre is given by

(A) $\frac{PL^2}{16EI}$ (B) $\frac{-PL^2}{16EI}$

(C) $\frac{PL^3}{48EI}$ (D) $\frac{PL^4}{54EI}$.

23. Hooke's law is obeyed by every material up to a

(A) viscous limit (B) proportional limit

(C) fracture (D) yield point.

24. Poisson ratio can be defined as

(A) $\frac{\text{Lateral stress}}{\text{Longitudinal stress}}$ (B) $\frac{E}{G}$

(C) $\frac{\text{Lateral strain}}{\text{Longitudinal strain}}$ (D) $\frac{G}{E}$.

25. If Mach No. is greater than unity, it implies that the flow is

(A) sonic (B) hypersonic

(C) subsonic (D) supersonic.

26. Consider the following two statements :

I. If heat is added to a system, its temperature must increase.

II. If positive work is done by a system in a thermodynamic process, its volume must increase.

Of these

(A) I and II are correct (B) I is correct, but II is wrong

(C) II is correct, but I is wrong (D) I and II are wrong.

SPACE FOR ROUGH WORK

27. Linear response in a vibration problem implies

(A) elements are in one line (B) response is not exponential

(C) response is along given line (D) sensitivity is constant.

28. Angular speed of a second hand of a clock is

(A) π rad/sec (B) $\frac{\pi}{6}$ rad/sec

(C) $\frac{\pi}{15}$ rad/sec (D) $\frac{\pi}{30}$ rad/sec.

29. Unwin's formula is used in design of

(A) welds (B) rivets

(C) shafts (D) gears.

30. Rated life of a bearing varies

(A) inversely as square of load (B) directly as square of load

(C) inversely as cube of load (D) directly as cube of load.

SECTION – II

Each question carries *two* marks. $15 \times 2 = 30$

31. The utilisation factor of a break-down maintenance system with a single crew is 80%. The expected number of machines down at any time will be

(A) 1 (B) 2

(C) 4 (D) 10.

32. In a single channel queue, if mean waiting time in the system is 50 mins and the mean waiting time in the queue is 30 mins, then the mean rate of service will be

(A) 3/hr (B) 10/hr

(C) 1/hr (D) 2/hr.

33. The flywheel of a steam engine has a radius of gyration of 1 m and mass 2500 kg. The starting torque of a steam engine is 1500 N-m and may be assumed constant. The angular acceleration of the flywheel is

(A) 0·2 rad/sec^2 (B) 0·6 rad/sec^2

(C) 0·7 rad/sec^2 (D) 0·1 rad/sec^2.

SPACE FOR ROUGH WORK

34. An instrument vibrates with a frequency of 1 Hz with no damping and while with damping a frequency of 0·9 Hz is observed. Damping factor of the system is

(A) 0·230 (B) 0·50

(C) 0·43 (D) 0·65.

35. A pair of 20° full depth involute spur gears having 30 and 50 teeth respectively with module of 4 mm are in mesh. The addendum of smaller gear will be

(A) 20·00 mm (B) 15·00 mm

(C) 19·00 mm (D) 18·57 mm.

36. The allowance in an assembly is 0·03 mm and shaft tolerance is 0·02 mm. The dimensions are specified as per basic hole system. The upper and lower limits of the hole are 25·02 and 25·00 mm respectively while the lower limit of shaft is 24·95 mm. The upper limit of shaft is

(A) 24·90 mm (B) 24·97 mm

(C) 20·54 mm (D) 24·00 mm.

37. A milling cutter having 8 teeth is rotating at 150 rpm. If feed/tooth is 0·1 mm, the table speed in mm/min is

(A) 125 (B) 120 (C) 100 (D) 115.

38. 0·5 m^3 of gas at 10 kPa and 120°C expands adiabatically to 1 kPa. It is then compressed isothermally to its original volume. Final temperature of gas will be

(Assume C_p = 1·005 kJ/kg K , C_v = 0·718 kJ/kg K)

(A) 0°C (B) – 64·3°C

(C) 24°C (D) 100°C.

39. A body at 1000°C in black surroundings at 500°C has an emissivity of 0·42 at 1000°C and emissivity of 0·72 at 500°C. The heat loss by radiation per unit area, when the body is grey with emissivity of 0·42, absorptivity is independent of the surface temperature, is

(A) 100 kW (B) 150 kW

(C) 54·89 kW (D) 80 kW.

SPACE FOR ROUGH WORK

40. The temperature of the inner surface of a plane brick wall is 50°C while its outer surface temperature is 25°C. Assuming wall thickness to be 220 mm and thermal conductivity of brick to be 0·51 W/mK, heat transfer per unit surface area in W/m^2 is

(A) 70 (B) 100

(C) 120 (D) 57·95.

41. The pressure within hydraulic cylinder press is 9 MPa. Inside diameter of the cylinder is 25 mm. For a permissible tensile stress of 18 N/mm^2, the thickness of the wall of the cylinder should be

(A) 7·00 mm (B) 10·00 mm

(C) 12·00 mm (D) 9·15 mm.

42. The major principal stress at a point within a steel member is + 200 MPa. If the uniaxial yield stress is 250 MPa, the magnitude of minor principal stress according to maximum shear stress theory is

(A) 200 MPa (B) 50 MPa

(C) 300 MPa (D) 100 MPa.

43. Length to radius ratio of a solid cylinder should be

(A) $\sqrt{3}$ (B) 2

(C) 4 (D) 1

to ensure that $I_{Longitudinal} = I_{Transverse}$.

44. The ratio of strain energies stored in the bar having square cross-section of side 4 cm and length 100 cm and cantilever beam of same cross-section and length of bar subjected to an axial load P is

(A) 100 (B) 2500 (C) 300 (D) 250.

45. A cylinder contains 0·45 m^3 of a gas at 1×10^5 N/m^2 and 80°C. The gas is compressed to 0·13 m^3 with final pressure being 5×10^5 N/m^2. The value of compression index assuming R = 294·2 J/kg°C and γ = 1·4 will be

(A) 1·0 (B) 1·3 (C) 1·2 (D) 1·5.

SPACE FOR ROUGH WORK

Note : **Please choose to answer Part – B below corresponding to your basi degree.**

PART – B

(AE : AUTOMOBILE ENGINEERING)

SECTION – I

Each question carries *one* mark. $20 \times 1 = 2$

46. The battery charger which generally employs a rectifier is

(A) constant voltage (B) constant current

(C) high rate (D) slow rate.

47. The most widely used cranking motor drive is

(A) barrel type (B) over running clutch

(C) Bendix drive (D) friction clutch drive.

48. The un-sprung mass of the vehicle includes

(A) the body (B) the engine

(C) the frame (D) the wheels.

49. The pitch-bounce model of an automobile is generally called

(A) full car model (B) half car model

(C) quarter car model (D) $\frac{3}{4}$ car model.

50. Irrespective of the value of damping, when the transmissibility is equal to 1, the rati of frequency of excitation to the natural frequency of the system will be

(A) $\sqrt{2}$ (B) $\sqrt{3}$

(C) $\sqrt{1{\cdot}414}$ (D) 1.

51. The difference between the maximum limit of size and minimum limit of size is called

(A) tolerance (B) upper deviation

(C) lower deviation (D) clearance.

SPACE FOR ROUGH WORK

52. If the dimension of a shaft is expressed as 50 ± 0·05 mm, it is the case of

(A) unilateral tolerance (B) limiting dimension

(C) bilateral tolerance (D) nominal size.

53. Which of the following is not a type of motion control system in CNC operation ?

(A) Point-to-point (B) Straight-out

(C) Contouring (D) Oblique.

54. The Central Computer, Bulk memory, Telecommunication lines and Machine tools are the components of a

(A) CNC system (B) DNC system

(C) NC system (D) CAD system.

55. The output device in CAD does not include in its category

(A) Plotters (B) Hard copy units

(C) Digitizers (D) COM units.

56. A 'square engine' means an engine having

(A) cylinder of square cross-section

(B) combustion chamber of square section

(C) equal bore diameter and stroke length

(D) piston of square cross-section.

57. The firing order of a 6-cylinder in-line engine is

(A) 1 – 5 – 4 – 3 – 6 – 2 (B) 1 – 5 – 3 – 6 – 2 – 4

(C) 1 – 3 – 2 – 4 – 6 – 5 (D) 1 – 4 – 6 – 3 – 5 – 2.

58. Valve overlap in an engine occurs between

(A) intake and compression strokes (B) compression and power strokes

(C) power and exhaust strokes (D) intake and power strokes.

SPACE FOR ROUGH WORK

59. For a given piston speed and mean effective pressure, doubling the cylinder diameter would result in

(A) increase of power four times (B) decrease of power four times

(C) decrease of power two times (D) increase of power two times.

60. One of the specifications of a battery by the manufacturer is

(A) the cranking current (B) the colour

(C) the weight (D) the cranking voltage.

61. In a spring (k) – mass (m) system, when the mass of the spring (m_s) is not small, the expression for the natural frequency of the system ω_n in rad/s will be

(A) $\sqrt{\frac{k}{m}}$ (B) $\sqrt{\frac{k}{m + m_s}}$

(C) $\sqrt{\frac{k}{m + \frac{m_s}{3}}}$ (D) $\sqrt{\frac{k}{m + 3m_s}}$.

62. The equation of motion of a machine [rotating at frequency ω rad/s] of mass M, with an unbalance mass m at radius e is given by

(A) $m\ddot{x} + c\dot{x} + kx = me\omega^2 \sin \omega t$ (B) $M\ddot{x} + c\dot{x} + kx = me\omega^2 \sin \omega t$

(C) $M\ddot{x} + c\dot{x} + kx = Me\omega^2 \sin \omega t$ (D) $m\ddot{x} + c\dot{x} + kx = Me\omega^2 \sin \omega t$.

63. In order to increase torque in an automobile, we have to

(A) decrease the power (B) decrease the fuel supply

(C) decrease the speed (D) increase the fuel supply.

64. The purpose of transmission in an automobile is to

(A) vary the speed of automobile (B) vary the torque at the road wheels

(C) vary the power of automobile (D) vary the speed of engine.

65. When the minimum permitted diameter of the shaft is larger than the maximum allowable diameter of the hole, the resulting type of fit is

(A) running fit (B) clearance fit

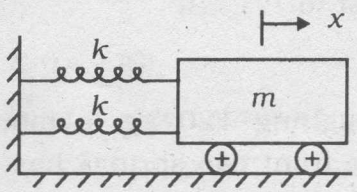
(C) transition fit (D) interference fit.

SPACE FOR ROUGH WORK

SECTION – II

Each question carries *two* marks. $10 \times 2 = 20$

66. A mass of m = 2 kg is attached to two identical springs, each of stiffness k = 15 kN/m as shown in figure. Under frictionless condition, the natural frequency of the system in Hz is close to



(A) 7 (B) 10

(C) 14 (D) 20.

67. A vehicle suspension system consists of a spring and a damper. The stiffness of the spring is 1·8 kN/m and the damping constant of the damper is 200 N-s/m. If the mass is 25 kg, the damping factor (τ) and the damped natural frequency (f_d) are

(A) 0·471 Hz and 1·19 Hz (B) 0·471 Hz and 7·48 Hz

(C) 0·666 Hz and 1·35 Hz (D) 0·666 Hz and 8·50 Hz.

68. The new coordinates of the line (2, 2) and (4, 6) after scaling by 2 units in x and y directions are

(A) (3, 4) and (6, 8) (B) (1, 1) and (3, 3)

(C) (4, 4) and (8, 12) (D) (2, 2) and (4, 8).

69. In a CNC program block, N002G02 G91 X40 240 ..... , G02 and G91 refers to

(A) circular interpolation in counter clockwise direction and incremental dimension

(B) circular interpolation in counter clockwise 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

70. The I.C. engine of an automobile has three cylinders of 68 mm bore and 74 mm stroke. The cubic capacity the engine in c.c. is closest to

(A) 806 (B) 780 (C) 1074 (D) 269.

71. A turbo charged direct injection diesel engine has displacement volume of 0·0259 m^3 [25·9 litres]. The engine has an output of 950 kW at 2200 rpm. The mean effective pressure [in MPa] is closest to

(A) 1 (B) 2 (C) 0·2 (D) 0·1.

72. An automotive engine weighing 120 kg is mounted on four springs of linear characteristics. Each of the front two springs has a striffness of 8 MN/m and while the stiffness of each rear spring is 16 MN/m. The engine speed (in rpm) at which resonance is likely to occur is

(A) 3020 (B) 6040

(C) 1424 (D) 955.

73. The gear ratios of a four speed gear box are 3·5, 2·1, 1·4 and 1·0. The constant ratio of differential is 6·0. If the engine speed is 4000 rpm and the rear wheel diameter is 0·6 m, the speed of the car (in kmph) in 2nd and 3rd gears respectively are nearly equal to

(A) 56 and 16 (B) 40 and 27

(C) 16 and 56 (D) 27 and 40.

74. The speed of an engine varies from 210 rad/s to 190 rad/s. During a cycle, the change in kinetic energy is found to be 800 Nm. The inertia of the flywheel in kgm^2 is

(A) 0·20 (B) 0·10

(C) 0·30 (D) 0·40.

75. A shaft has a dimension of $\phi\ 45^{-0.009}_{-0.025}$. The respective values of fundamental deviation and tolerance are

(A) – 0·025, ± 0·009 (B) – 0·025, 0·016

(C) – 0·009, ± 0·008 (D) – 0·009, 0·016.

SPACE FOR ROUGH WORK

PART – B

(MC : MECHANICAL ENGINEERING)

SECTION – I

Each question carries *one* mark. $20 \times 1 = 20$

46. Principle of scientific management was given by

(A) Gilbreth (B) Greet Hotstede

(C) Elton Mayo (D) Frederick Taylor.

47. The specific speed of a centrifugal compressor is generally

(A) higher than that of an axial compressor

(B) less than that of a reciprocating compressor

(C) independent of the type of compressor, but depends only on the size of the compressor

(D) more than the specific speed of the reciprocating compressor but less than that of the axial compressor.

48. Kaplan turbine is

(A) a high head mixed flow turbine (B) a low axial flow turbine

(C) an outward flow reaction turbine (D) an impulse inward flow turbine.

49. In a gas turbine, hot combustion product with the specific heat C_p = 0·98 kJ/kg K and C_v = 0·7538 kJ/kg K enters the turbine at 20 bar 1500 K and exits at 1 bar. The isentropic efficiency of the turbine is 0·94. Work developed by the turbine per kg of gas flow is

(A) 689·64 kJ/kg (B) 794·66 kJ/kg

(C) 1009·72 kJ/kg (D) 1312·00 kJ/kg.

50. Pelton turbine is

(A) a high head and low discharge turbine

(B) a medium head and medium discharge turbine

(C) a low head and medium discharge turbine

(D) a high head and high discharge turbine.

SPACE FOR ROUGH WORK

51. The first algorithm for Linear Programming was given by

(A) Bellman (B) Dantzig

(C) Kulm (D) Von Neumann.

52. Auto collimotor is used to check

(A) roughness (B) flatness

(C) angle (D) automobile balance.

53. In the specification of dimensions and fits,

(A) allowance is equal to bilateral tolerance

(B) allowance is equal to unilateral tolerance

(C) allowance is independent of tolerance

(D) allowance is equal to the difference between maximum and minimum dimensions specified by the tolerance.

54. Which among the NC operations given below are continuous path operations ?

Arc welding (AW), Milling (M), Drilling (D), Punching of sheetmetal (P), Laser cutting of sheetmetal (LC), Spot welding (SW).

(A) AW, LC and M (B) AW, D, LC and M

(C) D, LC, P and SW (D) D, LC and SW.

55. NC contouring is an example of

(A) continuous path positioning (B) point-to-point positioning

(C) absolute positioning (D) incremental positioning.

56. Heat transfer from higher temperature to lower temperature takes place according to

(A) Fourier law (B) 1st law of thermodynamics

(C) 2nd law of thermodynamics (D) Zeroth law of thermodynamics.

57. For heat trnasfer through a single cylindrical shell with convection of the outside, there is a value for the shell radius for a non-zero shell thickness at which the heat flux is maximised. This value is

(A) k/h (B) h/k (C) h/r (D) r/h.

SPACE FOR ROUGH WORK

58. For the same inlet and outlet temperature of hot and cold fluids, the log mean temperature difference (LMTD) is

(A) greater for parallel flow heat exchanger than for counter flow heat exchanger

(B) greater for counter flow heat exchanger than for parallel flow heat exchanger

(C) same for both parallel flow and counter flow heat exchanger

(D) depends on the properties of the fluids.

59. Air flows over a rectangular plate having dimensions 0·5 m × 0·25 m. The free stream temperature of the air is 300°C. At steady state, the plate temperature is 40°C. If the connective heat transfer coefficient is 250 $W/m^2 K$, the heat transfer rate from the air to one side of the plate is

(A) 8200 W (B) 8250 W

(C) 8125 W (D) 8150 W.

60. Maslow's theory of needs is in the order

(A) physiological, safety, social, esteem, self actualisation

(B) safety, social, esteem, self actualisation, physiological

(C) social, esteem, physiological, safety, self actualisation

(D) esteem, self actualisation, social, safety, physiological.

61. In a control system the output of the controller is given to

(A) final control element (B) amplifier

(C) comparator (D) sensor.

62. In pneumatic control system the control valve used as final control element converts

(A) pressure signal to electric signal

(B) pressure signal to position change

(C) electrical signal to pressure signal

(D) position change to pressure signal.

63. The most commonly used criteria for measuring forecast error is

(A) mean absolute deviation (B) ordering cost of raw material

(C) mean standard error (D) mean square error.

SPACE FOR ROUGH WORK

64. Which one of the following forecasting techniques 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.

65. A dummy activity is used in PERT network to describe

(A) precedence relationship (B) necessary time delay

(C) resource restriction (D) resource idleness.

SECTION – II

Each question carries *two* marks. $10 \times 2 = 20$

66. A sphere of diameter 10 mm and emissivity 0·9 is maintained at 80°C inside an oven with a wall temperature of 400°C. What is the net heat transfer rate from the oven walls to the object ?

(A) 3·04 W (B) 3·2 W

(C) 3·08 W (D) 3·12 W.

67. The following data pertain to a single stage impulse steam turbine :

Nozzle angle = 20°, Blade velocity = 200 m/sec,

Relative steam velocity at entry = 350 m/sec,

Blade inlet angle = 30°, Blade exit angle = 25°.

If the blade friction is neglected, the work done per kg of steam is

(A) 124 kJ (B) 164 kJ

(C) 169 kJ (D) 174 kJ.

68. 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.

SPACE FOR ROUGH WORK

69. Which type of motor is *not* used in axis or spindle drives of CNC machine tools ?

(A) Induction motor (B) D.C. servo motor

(C) Stepper motor (D) Linear servo motor.

70. The properties of mercury at 300 K are

Density = 13529 kg/m^3, Specific heat at constant pressure = 0·1393 kJ/kg K, Dynamic viscosity = $0{\cdot}1523 \times 10^{-2}$ N-s/m^2 and Thermal conductivity = 8·540 W/mK. The Prandtl number of the mercury at 300 K is

(A) 0·0248 (B) 2·48

(C) 24·8 (D) 248.

71. In a counter flow heat exchanger, for the hot fluid the heat capacity = 2 kJ/kg K, Mass flow rate = 5 kg/sec, Inlet temperature = 150°C, Outlet temperature = 100°C. For the cold fluid heat capacity = 4 kJ/kg K, Mass flow rate = 10 kg/K, Inlet temperature = 20°C. Neglect the heat transfer to the surroundings. The outlet temperature of the cold fluid in °C is

(A) 7·5 (B) 32·5

(C) 45·5 (D) 70·0.

72. The following data pertain to a Pelton turbine.

Head available = 450 m, discharge = 0·3 m^3/sec,

overall efficiency of Pelton turbine = 0·8.

Power produced by the turbine is

(A) 1080 kW (B) 1060 kW

(C) 1000 kW (D) 1020 kW.

73. The sales of a product during the last four years were 860, 880, 870 and 890 units. The forecast for the fourth year was 876 units. If the forecast for the fifth year, using simple exponential smoothing is equal to the forecast using a three period moving average, the value of the exponential smoothing constant α is

(A) $\frac{1}{7}$ (B) $\frac{1}{5}$

(C) $\frac{2}{7}$ (D) $\frac{2}{5}$.

SPACE FOR ROUGH WORK

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 G02 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. An item can be purchased for Rs. 100. The ordering cost Rs. 200 and the inventory carrying cost is 10% of the item cost annum. If the annual demand is 4000 units, then economic order quantity (in units) is

(A) 50 (B) 100 (C) 200 (D) 400.

PART – B

(IPE : INDUSTRIAL AND PRODUCTION ENGINEERING)

SECTION – I

Each question carries *one* mark. $20 \times 1 = 20$

46. Magnetic particle test

(A) is employed for non-ferrous materials

(B) is adapted for ferromagnetic materials

(C) is used to identify defects deep inside the material

(D) needs a dye to be employed.

47. The process involving the heating of steel above upper critical temperature and then cooling it in a furnace is known as

(A) tempering (B) normalising

(C) hardening (D) annealing.

48. The subdivision of an operation into Therbligs and their analysis is known as

(A) work study (B) time study

(C) micro motion study (D) none of these.

SPACE FOR ROUGH WORK

49. The mathematical technique for finding the best use of limited resources of a concern in an optimum manner is known as

(A) Queuing theory (B) Network analysis

(C) Value analysis (D) Linear programming.

50. 'Drawing down' operation is a / an

(A) Rolling process (B) Drawing process

(C) Forging process (D) Extrusion process.

51. To avoid any frictional drag of the tool on the job, the single point tool geometry provides

(A) Rake angle (B) Nose radius

(C) Clearance angle (D) None of these.

52. An optical comparator's main advantage is that

(A) it has a small number of moving parts

(B) electric supply is not necessary

(C) the size is compact

(D) none of these.

53. Continuous chips without built-up edge are produced while machining

(A) brittle materials

(B) ductile materials

(C) at high pressure and friction at tool face

(D) none of these.

54. Translation, one of the transformations performed through a graphics package means

(A) moving the image from one location on the screen to another position

(B) turning the image through a desired angle

(C) reducing the size of the image

(D) selective erasure of the image.

SPACE FOR ROUGH WORK

55. The saddle point in theory of games is the point where

(A) MAXIMIN for A = MINIMAX for B

(B) MAXIMIN for A > MINIMAX for B

(C) MAXIMIN for A < MINIMAX for B

(D) None of these.

56. At the breakeven point

(A) fixed cost and variable cost are equal

(B) sales revenue and total cost are equal

(C) sales revenue is more than the total cost

(D) sales revenue is less than the total cost.

57. A chart in which time values are recorded and motions are classified by Therbligs is called

(A) SIMO chart (B) Operation chart

(C) GANTT chart (D) Process chart.

58. A comparator gives

(A) actual measurement

(B) magnified signal only

(C) dimensional differences in relation to a basic dimension

(D) none of these.

59. In a Direct Beam Refresh Tube type of display unit

(A) there is no staircasing effect

(B) a cathode ray tube is made use of

(C) there is no colour capability

(D) selective erasure is possible.

SPACE FOR ROUGH WORK

60. Light Pen used in CAD is

(A) an output device

(B) an input device

(C) a potentiometric device

(D) a device that is used with storage tube.

61. Extrusion is a

(A) metal cutting process (B) metal forming process

(C) method of heat treatment (D) casting process.

62. In double sampling plan

(A) a single sample is taken from the lot at random

(B) one, two, three or more samples are drawn

(C) if the first sample is defective, then a second sample is taken

(D) none of these.

63. Which of the following charts is used as a control chart for variables ?

(A) *C*-chart (B) $\overline{X}$ -chart

(C) *P*-chart (D) None of these.

64. 'Therbligs' is a set consisting which of the following numbers of elementary motions ?

(A) 15 (B) 19

(C) 17 (D) 16.

65. Flank wear in a single point cutting tool

(A) is the wear on the clearance face of the tool

(B) is the wear at the chip-tool interface and occurs as a depression

(C) is the wear on the flank below the cutting edge

(D) none of these.

SPACE FOR ROUGH WORK

SECTION – II

Each question carries *two* marks. $10 \times 2 = 20$

66. In orthogonal cutting

(A) the tool is set with its cutting edge at an angle to the direction of tool travel

(B) the chip flows with a sideward movement

(C) the tool is set with its cutting edge perpendicular to the direction of tool travel

(D) three components of cutting forces are acting on the tool.

67. When operating with roughing cuts on mild steel at 18 m/min, a certain tool gave a life of 3 hours between regrinds. The life of this tool on similar cuts at a speed of 24 m/min will be $\left(\text{take } n = \frac{1}{8} \right)$

(A) 18 mins (B) 16·5 mins (C) 19·8 mins (D) 14·6 mins.

68. Rolling is a / an

(A) continuous chip-forming metal cutting process

(B) continuous chipless metal cutting process

(C) intermittent chipless production process

(D) metal cutting process with fine chips.

69. A boiler was purchased for Rs. 45,000 on 1st January, 1946. The erection and installation work cost Rs. 7,000. The boiler was replaced by a new one on 31st December, 1965. If the scrap value was estimated at Rs. 15,000, the Depreciation value of boiler per year using straight line method would be

(A) Rs. 1,350 (B) Rs. 1,530

(C) Rs. 1,580 (D) Rs. 1,850.

70. Work measurement is concerned with establishing

(A) standard job

(B) a time standard for a specific task

(C) the number of jobs for a given time

(D) none of these.

SPACE FOR ROUGH WORK

71. Interference fit results when there is a

(A) – *ve* allowance between the largest hole and the smallest shaft, the shaft being larger than the hole

(B) + *ve* allowance between largest possible shaft and the smallest possible hole, hole being larger than the shaft

(C) zero allowance between the shaft and the hole

(D) none of these.

72. In surface models

(A) a solid is represented by part geometry and topology

(B) a solid is represented by part geometry only

(C) a solid is stored in memory as stick-figure structures

(D) a solid is constructed using the primitives.

73. In a contouring or continuous path CNC system,

(A) slides can move to a preprogrammed location along one axis at a time

(B) slide motion in more than one axis is controlled continuously and simultaneously

(C) interpolators are not used

(D) slides have continuous motion along one axis at a time.

74. In a cylindrical co-ordinate Robot configuration

(A) the robot body is a vertical column that swivels about a vertical axis

(B) the robot has a rotary base, a main body that tilts and a horizontal arm that slides in and out

(C) the robot has three linear axes mutually perpendicular to each other with sliding joints

(D) none of these.

75. A transportation problem has a feasible solution only if

(A) total supply > total demand (B) total supply = total demand

(C) the matrix is a square one (D) none of these.

SPACE FOR ROUGH WORK

PART – B

(IEM : INDUSTRIAL ENGINEERING AND MANAGEMENT)

SECTION – I

Each question carries *one* mark. $20 \times 1 = 20$

46. A language for simulating models of business acitivity is

(A) SPSS (B) PL/I

(C) GPSS (D) COBOL.

47. When the ordering cost is increased to 4 times, the EOQ will be increased to

(A) 3 times (B) 8 times

(C) remain same (D) 2 times.

48. In PERT the distribution of activity time is assumed to be

(A) Normal distribution (B) Binomial distribution

(C) Beta distribution (D) Gamma distribution.

49. The cost of inventory does not include

(A) ordering cost (B) material cost

(C) carrying cost (D) shortage cost.

50. The optimality of a transportation problem is determined by the application of

(A) North-west corner rule method (B) Row minima method

(C) Vogel's approximation method (D) Stepping stone method.

51. If the Primal Problem gives an unbounded solution in an LPP, the dual of the same will give

(A) optimal solution (B) unbounded solution

(C) infeasible solution (D) basic feasible solution.

SPACE FOR ROUGH WORK

52. Gang Process Chart is another type of

(A) Flow process chart (B) Mutiple activity chart

(C) Travel chart (D) Simo chart.

53. Formula for memory capacity is

(A) $MC = \frac{2}{N}$ (B) $MC = \frac{N}{2}$

(C) $MC = N^2$ (D) $MC = 2^N$

54. In a $n \times n$ matrix of an assignment problem, the optimality is reached when the minimum number of straight lines scoring all the zeros is

(A) n^2 (B) $\frac{1}{n}$

(C) $2n$ (D) n.

55. An information system that responds immediately to the needs of the physical system is called

(A) Inline system (B) Online system

(C) Offline system (D) Real time system.

56. In MTM one TMU is equal to

(A) 0·0006 minute (B) 0·0008 minute

(C) 0·0005 minute (D) 0·0009 minute.

57. If the observed time for an element is 0·4 minute, the observed rating is 120 per cent, then the normal time would be

(A) 0·43 minute (B) 0·48 minute

(C) 0·40 minute (D) 0·60 minute.

58. In a Poisson distribution mean is 16, the variance is

(A) 4 (B) 2

(C) 16 (D) 8.

SPACE FOR ROUGH WORK

59. The control chart used for measuring variability, when the sample size is large, is

(A) *P*-chart (B) *C*-chart

(C) *U*-chart (D) σ-chart.

60. The father of scientific management is

(A) F. W. Taylor (B) Gilbreth B.

(C) Henry Fayol (D) Russell Roff.

61. The error of instruments can be determined by

(A) Calibration (B) Slip gauge

(C) Optical projector (D) Snap gauge.

62. A feeler gauge is used to check

(A) radius (B) screw pitch

(C) surface roughness (D) thickness of clearence.

63. Which of the following is not the angle measuring device ?

(A) Angle plate (B) Sine bar

(C) Bevel protractor (D) Angle gauge.

64. The technique used for finding product mix in an optimum manner is

(A) Queueing theory (B) Network

(C) Replacement analysis (D) Linear programming.

65. The difference between the time available to do the job and the time required to do the job is called

(A) event (B) float

(C) constraint (D) duration.

SPACE FOR ROUGH WORK

SECTION – II

Each question carries *two* marks. $10 \times 2 = 20$

66. The variance of the population is 36 and the sample size is 4. The standard error of the sample is

(A) 3 (B) 4 (C) 5 (D) 6.

67. In transportation problems, there are 5 supply centres and 6 demand centres. The total quantity of supply available is greater than the total demand. The number of allocations without degeneracy during an iteration is

(A) 10 (B) 9 (C) 11 (D) 12.

68. The standard tolerance unit is equal to

(A) $0{\cdot}45 \left(\sqrt[3]{D} \right) + 0{\cdot}001\ D$ (B) $0{\cdot}45 \left(\sqrt{D} \right) + 0{\cdot}001\ D$

(C) $0{\cdot}45 \left(\sqrt[3]{D} \right) + 0{\cdot}01\ D$ (D) $0{\cdot}45 \left(\sqrt[4]{D} \right) + 0{\cdot}01\ D$.

69. Maximized value for the objective function

$$Z = 5x_2 - x_1$$

subject to constraints

$$2x_1 + 5x_2 \leq 80$$

$$x_1 + x_2 \leq 20$$

$$x_1,\ x_2 \geq 0$$

is

(A) 40 (B) 60 (C) 80 (D) 100.

70. If the observed time for an element is 2 minutes per piece, the observed rating of the operator is 110 and 10% personal allowance is provided. The standard time per piece is

(A) 2·44 min (B) 2·42 min

(C) 2·48 min (D) 2·46 min.

SPACE FOR ROUGH WORK

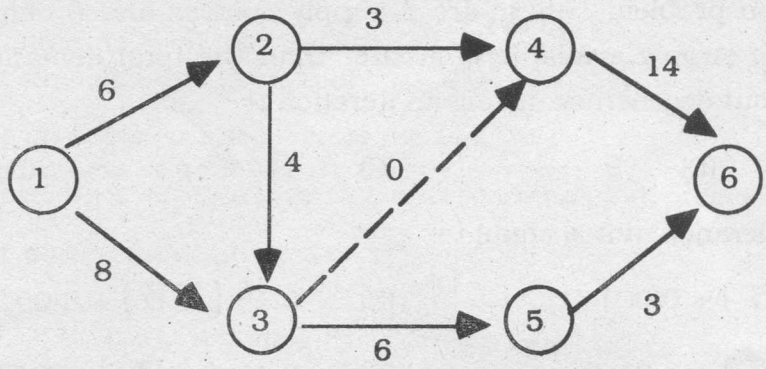
71. A single sampling plan is as follows :

$n = 60$, $N = 1{,}000$, the probability of acceptance of the lot at 1% defective is 0·8.

The ATI of the plan is

(A) 248 (B) 260 (C) 240 (D) 280.

72. For the network shown in the figure, the variance along the critical path is 9.



The probability of completion of the project in 24 days is

(A) 68·2% (B) 84·1% (C) 95·4% (D) 50%.

73. A process is to be controlled with standard values of mean = 18 and the standard deviation is equal to 4. The sample size is 9. The control limits for $\overline{X}$-chart are

(A) 18 ± 9 (B) 18 ± 6

(C) 18 ± 4 (D) 18 ± 3.

74. In a point-to-point control NC machine, the slide is positioned by an integrally mounted stepper motor drive. If the motor specification is 1°/pulse and the pitch of the lead screw is 3·6 mm, the expected positioning accuracy is

(A) 1 μm (B) 10 μm

(C) 50 μm (D) 100 μm.

75. The mean and variance of consumption of an item are 200 and 36 respectively. The area under the normal curve for $z = 2$ is 0·95. The re-order level for 95% service level is

(A) 236 (B) 206

(C) 212 (D) 218.

SPACE FOR ROUGH WORK

PART – B

(MSE : MANUFACTURING SCIENCE AND ENGINEERING)

SECTION – I

Each question carries *one* mark. $20 \times 1 = 20$

46. In which of the following forging machines is the velocity maximum ?

(A) HERF machines (B) Gravity drop hammer

(C) Power drop hammer (D) Mechanical press.

47. The production rate is reciprocal of

(A) work handling time (B) inspection time

(C) packing time (D) production time.

48. The basis for group technology is parts having similar characteristics in

(A) mechanical properties (B) chemical properties

(C) design and manufacturing (D) physical properties.

49. Which of the following is not the correct method of specifying numerical value of surface roughness ?

(A) CLA value (B) Mean line and envelope line systems

(C) RMS value (D) Peak-to-valley height.

50. Optical gauge works on the principle of

(A) interference of light rays (B) dispersion of light rays

(C) reflection of light rays (D) refraction of light rays.

51. A critical path has

(A) zero slack (B) minimum slack

(C) negative slack (D) maximum slack.

52. In the PERT network the durations of activities are considered to be

(A) normal distribution (B) beta distribution

(C) linear distribution (D) exponential distribution.

SPACE FOR ROUGH WORK

53. Ionization pressure gauge is used to measure

(A) pressure of the range 0·00001 micron to one micron

(B) low pressures

(C) medium pressures

(D) pressure of the order of 10 microns.

54. In conical dies, the die angle is equal to

(A) 80° - 90° (B) 70° - 80°

(C) 45° - 60° (D) 60° - 70°.

55. Ability of a cutting tool to withstand high temperatures without losing its cutting edge is

(A) toughness (B) wear resistance

(C) strength (D) hot hardness.

56. In HSS tools, 18 – 4 – 1 indicates

(A) 18% tungsten, 4% chromium, 1% vanadium

(B) 18% chromium, 4% tungsten, 1% vanadium

(C) 18% vanadium, 4% tungsten, 1% chromium

(D) 18% chromium, 4% vanadium, 1% tungsten.

57. Octagonal rings are used in

(A) turning dynamometer (B) grinding dynamometer

(C) milling dynamometer (D) drilling dynamometer.

58. In oxidising flame, the proportion of oxygen and acetylene is

(A) 2 : 1 (B) 1 : 3

(C) 3 : 1 (D) 1·5 : 1.

SPACE FOR ROUGH WORK

59. In laser welding, flash tube converts

(A) electrical energy to mechanical energy

(B) electrical energy to light energy

(C) mechanical energy to electrical energy

(D) light energy to electrical energy.

60. Workability limit diagram relates

(A) shear strain and compressive strain

(B) shear stress and compressive stress

(C) tensile strain and compressive strain

(D) tensile stress and compressive stress.

61. Arc welding robot is an application of

(A) point-to-point robot control (B) straight line robot control

(C) continuous path robot control (D) adaptive robot control.

62. The devices used to measure position, velocity or acceleration of robot joints or end effector are called

(A) proximity devices (B) external state sensor

(C) visual sensor devices (D) internal state sensor.

63. A modelling technique which uses few important dimensions of a model and calculates other dimensions of the model using empirical relationships is called

(A) Parametric modelling (B) Variational modelling

(C) Constraint driven modelling (D) Feature based modelling.

64. Which of the following generates pulses corresponding to the rotation of motor in CNC machine ?

(A) Micro-controller (B) Encoder

(C) LVDT (D) Proximity sensor.

65. A computer which serves number of computer controlled machines in a cell is

(A) CNC (B) NC

(C) DNC (D) FMS.

SPACE FOR ROUGH WORK

SECTION – II

Each question carries *two* marks. $10 \times 2 = 20$

66. If production capacity is 1600 parts, actual production is 1000 parts, what is utilization ?

(A) 60% (B) 70%

(C) 160% (D) 62·5%.

67. The order of welding cycle in resistance welding is

(A) hold time, weld time, squeeze time, off time

(B) squeeze time, weld time, hold time, off time

(C) squeeze time, hold time, welding time, off time

(D) weld time, squeeze time, hold time, off time.

68. Which one of the following is required to communicate between work stations at different locations separated by a considerable distance ?

(A) USB (B) MODEM

(C) CABLE (D) CARD.

69. The rotation of θ degrees about the x-axis of a reference coordinate system of a robot is given by

(A) $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -\sin\theta & \cos\theta & 0 \\ 0 & \cos\theta & \sin\theta & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & \cos\theta & -\sin\theta & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \sin\theta & -\cos\theta & 0 \\ 0 & \cos\theta & \sin\theta & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$.

SPACE FOR ROUGH WORK

70. In a turning operation, the chip thickness ratio is 0·4, rake angle is 20°. What is the shear plane angle ?

(A) 23·5° (B) 15°

(C) 30° (D) 5°.

71. If V_o is the velocity of the slab at the entrance, V_n is the velocity of the slab at the neutral plane, then the backward slip is equal to

(A) $\frac{V_o - V_n}{V_n}$ (B) $V_n \left(V_o - V_n \right)$

(C) $\frac{V_n - V_o}{V_n}$ (D) $\frac{V_n}{V_o - V_n}$.

72. The standard tolerance unit (I) in the case of limits and fits for sizes above 500 mm and up to 3150 mm is D is in mm.

(A) $0{\cdot}45 \left(\sqrt[3]{D} \right) + 0{\cdot}001\ D$ (B) $0{\cdot}52 \left(\sqrt[3]{D} \right) + 0{\cdot}001\ D$

(C) $0{\cdot}004\ D + 2{\cdot}1$ (D) $0{\cdot}30 \left(\sqrt[3]{D} \right) + 0{\cdot}42\ D$.

73. Expressing a dimension as $25{\cdot}3^{\pm 0{\cdot}05}$ mm is the case of

(A) bilateral tolerance (B) unilateral toberance

(C) limiting dimensions (D) angular tolerance.

74. PERT has which of the following time estimates ?

(A) One time estimate (B) Four tme estimate

(C) Mill time estimate (D) Two time estimate.

75. Resistive type strain gauges are normally quite sensitive to

(A) pressure (B) torque

(C) temperature (D) cross-sectional area of wire.

SPACE FOR ROUGH WORK