PGCET-2013

006

DAY and TIME	COURSE	SUBJECT
DAY-1 10.30 am to 12.30 pm SESSION : FORENOON	ME/M.Tech/M.Arch/MBA (Infrastructure Management) 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 DETAILS	
					VERSION CODE	SERIAL NUMBER
					A - 1	140837

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 and also ensure the circle against the appropriate paper you are answering in Part-B is also shaded.
3. This Question Booklet is issued to you by the invigilator after the **2nd Bell i.e., after 10.25 a.m.**
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 a.m., till then;**
   - Do not remove the paper seal / polythene bag 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 a.m.,** remove the paper seal / polythene bag 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 BALL POINT 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, 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 I) 30 Questions : $30 \times 1 = 30$ (Section II) 15 Questions : $15 \times 2 = 30$
Part-B : (Section I) 20 Questions : $20 \times 1 = 20$ (Section II) 10 Questions : $10 \times 2 = 20$

SEAL

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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 75 are optional. Sub-branches are there in this Booklet. The candidate has to opt any one branch according to his/her Application Form.

Sub-branch	Subject	Page No.	
		From	To
1.	Automobile Engineering (AE)	9	13
2.	Mechanical Engineering (MC)	14	18
3.	Industrial and Production Engineering (IPE)	19	22
4.	Industrial Engineering and Management (IEM)	23	27
5.	Manufacturing Science and Engineering (MSE)	28	31

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MECHANICAL SCIENCES
PART – A
(COMMON to AE/MC/IPE/IEM/MSE)
SECTION – I

Each question carries one mark. **(30 × 1 = 30)**

1. The rank of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 1 & 4 & 2 \\ 2 & 6 & 5 \end{bmatrix}$ is _____

(A) 5 (B) 4
(C) 3 (D) 2

2. The Maclaurin's series of expansion of log (1 + x) is _____

(A) $x - x^3/3 + x^5/5 + \ldots\ldots$
(B) $x + x^2/2! + x^3/3! + x^4/4! + \ldots\ldots$
(C) $x - x^2/2! + x^3/3! - x^4/4! + \ldots\ldots$
(D) $1 + x - x^2/2! + x^3/3! - x^4/4! + \ldots\ldots$

3. $\int_0^2 \int_0^x (x + y)\, dx\, dy =$ _____

(A) 4 (B) 3
(C) 5 (D) None of these

4. A force field $\vec{F}$, is said to be conservative if _____

(A) Curl $\vec{F} = 0$ (B) Grad $\vec{F} = 0$
(C) div $\vec{F} = 0$ (D) Curl (grad $\vec{F}$) = 0

5. The structure which have the highest packing of atoms are

(A) Hexagonal closed packed lattice
(B) Body central cubic lattice
(C) Simple cubic lattice
(D) None of these

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6. The temperature at or above which a ferromagnetic material becomes paramagnetic is called
   (A) Critical temperature
   (B) Immersion temperature
   (C) Curie temperature
   (D) Debye temperature

7. Silicon steel is widely used in
   (A) Cutting tools
   (B) Dies and punches
   (C) Electrical industry
   (D) Chemical industry

8. The higher stress that a material can withstand for a specified length of time without excessive deformation is
   (A) Fatigue strength
   (B) Creep strength
   (C) Endurance strength
   (D) Creep rupture strength

9. Malleability property is related to
   (A) Resistance to indentation
   (B) Cold rolling
   (C) Elongation
   (D) Wire drawing

10. The allowable stress in a column can be increased by
   (A) increasing slenderness ratio.
   (B) increasing the radius of gyration.
   (C) increasing the length of the column.
   (D) None of the above

11. A body which is immersed in water and is in stable equilibrium. The center of buoyancy
   (A) coincides with CG.
   (B) lies on the vertical plane passing through and above CG.
   (C) lies on the vertical plane passing through and below CG.
   (D) None of the above

12. The existence of velocity potential implies that
   (A) Fluid is ideal
   (B) Fluid is compressible
   (C) Fluid is irrotational
   (D) Fluid is in continuum

13. An ideal fluid is one which
   (A) is incompressible.
   (B) is incompressible and has small surface tension.
   (C) is non-viscous, incompressible and has no surface tension.
   (D) is compressible, viscous, colourless and has small surface tension.

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14. Second law of thermodynamics defines

(A) Heat (B) Work
(C) Enthalpy (D) Entropy

15. In which of the following processes work done (during the process) can be determined by $\int pdv$?

(A) Isothermal (B) Adiabatic
(C) Quasi-static (D) Isentropic

16. What will happen if petrol is used in diesel engine ?

(A) Black smoke will be produced (B) Low power will be produced
(C) Higher knocking will occur (D) Efficiency will be low

17. The critical speed of shaft is affected by

(A) Span of the shaft (B) Diameter of the disc
(C) Eccentricity (D) All of the above

18. Cam profile is the

(A) Actual working contour of the cam
(B) Path traced by a cam follower
(C) Total surface area of the cam
(D) Profile of path traced by a cam follower

19. In the assembly design of shaft, pulley and key, the weakest member is

(A) Pulley (B) Key
(C) Shaft (D) None of the above

20. ASME code equation for shaft design is based on

(A) Maximum shear stress theory (B) Von-mises theory
(C) Goodman diagram (D) Soderberg criterion

21. A screw is said to be overhauling if

(A) Negative torque is obtained
(B) Efficiency is more than 50%
(C) Friction angle is less than helix angle
(D) All of the above

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22. A flexible coupling can be used for
(A) Axial misalignment
(B) Angular misalignment
(C) Both the above
(D) Can only be used for aligned shafts

23. In thick film hydrodynamic journal bearings, the co-efficient of friction
(A) increases with increase in load
(B) is independent of load
(C) decrease with increase in loads
(D) may increase or decrease with increase in load

24. Arrange the following processes in ascending order of their cutting speeds :
1. Drilling 2. Turning 3. Milling 4. Grinding
Of these
(A) $1 < 2 < 3 < 4$
(B) $2 < 1 < 4 < 3$
(C) $3 < 2 < 1 < 4$
(D) $3 < 4 < 2 < 1$

25. Which of the following statements is incorrect about the discontinuous chip ?
(A) Formed while machining brittle materials at low cutting speed
(B) Formed when feed & depth of cut are high
(C) Formed due to high tool cutting friction
(D) None

26. Which of the following casting defects appears as a projection on the surface of casting ?
(A) Misrun
(B) Pin holes
(C) Scabs
(D) Cold shuts

27. The chart for attribute type data is
(A) C-chart
(B) P-chart
(C) V-chart
(D) All the three

28. The founder of motion study is
(A) F W Taylor
(B) Frank B Gilbreth
(C) Barnes
(D) Maslow

29. A dummy activity
(A) is artificially introduced
(B) is represented by dotted line
(C) does not require any time
(D) all of the above

30. The error of instruments can be determined by
(A) Calibration
(B) Slip gauge
(C) Optical projector
(D) Snap gauge

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SECTION – II

Each question carries two marks. **(15 × 2 = 30)**

31. A vehicle starts from rest and accelerates at a rate of 4 m/s^2 for 10 seconds and decelerates at 8 m/s^2 until stops. The total distance covered is

(A) 300 m (B) 200 m (C) 500 m (D) 100 m

32. Moment of inertia of a triangular section about an axis passing through its base is given by

(A) $bh^3 / 32$ (B) $bh^3 / 12$ (C) $bh^3 / 36$ (D) all of the above

33. Calculate the specific weight, specific mass and specific gravity of a liquid having a volume of 6 m^3 and weight of 44 kN

(A) 53.3 kN/m^3, 547.5 kg/m^3, 0.447
(B) 6.33 kN/m^3, 647.5 kg/m^3, 0.547
(C) 7.33 kN/m^3, 747.5 kg/m^3, 0.747
(D) all of the above

34. A particle is projected at an angle θ to the horizontal and it attains a maximum height H. The time taken by the projectile to reach the highest point of its path is

(A) $\sqrt{\frac{H}{g}}$ (B) $\sqrt{\frac{2H}{g}}$ (C) $\frac{\sqrt{2H \sin\theta}}{g}$ (D) $\frac{\sqrt{2H}}{\sin\theta}$

35. E, G, K and ν stands for elastic modulus, shear modulus, bulk modulus, and poisson's ratio respectively for a linear elastic isotropic and homogeneous material. To define or relate stress-strain relation completely for these materials at least

(A) E, G and ν must be known
(B) E, K and ν must be known
(C) Any two of the four must be known
(D) All four must be known

36. The ratio of bulk modulus (K) and modulus of Elasticity (E) for any isotropic elastic material is

(A) $1/3(1-2\nu)$ (B) $1/3(1+2\nu)$ (C) $3(1+2\nu)$ (D) $3(1-2\nu)$

37. A fluid is said to be Newtonian with shear stress is

(A) independent of velocity gradient.
(B) directly proportional to velocity gradient.
(C) inversely proportional to velocity gradient.
(D) all of the above.

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38. The co-efficient of discharge C_d of an orifice varies with

(A) Reynold's number (B) Mach number
(C) Prandtl number (D) Weber number

39. A heat engine receives heat at the rate of 1500 kJ/min and gives an output of 8.2 kW. Its thermal efficiency is equal to

(A) 20.5% (B) 30.2 % (C) 32.8% (D) 44.6%

40. For a kinematic chain formed by a lower pair, the relation between the number of link (L) and number of joint (J) is

(A) L=3/2 (J+2) (B) L= 2/3 (J+2) (C) L= 2/3(J+3) (D) L=3/2(J+3)

41. If S_1 and S_2 are spring forces exerted on the sleeve at maximum and minimum radii of rotation respectively, h is lift of sleeve, then stiffness of spring in Hartnell governor is equal to

(A) $(S_1+S_2)/2h$ (B) $(S_1-S_2)/2h$ (C) $(S_1-S_2)/h$ (D) $(S_1+S_2)/h$

42. If m is mass, s is stiffness and δ is static deflecting of the body, then natural frequency of free longitudinal vibrations is given by

(A) $1/2\pi\sqrt{g/\delta}$ (B) $1/2\pi\sqrt{s/m}$
(C) $4.985/\sqrt{\delta}$ (D) all of the above

43. A two stroke I.C engine has a mean effective pressure of 6 bar. The speed of the engine is 1000 rpm and the diameter of the piston and stroke are 110 mm and 140 mm respectively. What is the indicated power developed ?

(A) 10.3 kW (B) 13.3 kW
(C) 15.3 kW (D) 20.3 kV

44. A hollow shaft of outer diameter 40 mm and inner diameter 20 mm is to be replaced by a solid shaft to transmit the same torque at the same maximum stress. What should be the diameter of shafts ?

(A) 30 mm (B) 35 mm
(C) $10 \times (60)^{1/3}$ mm (D) $10 \times (20)^{1/3}$ mm

45. A spring of stiffness 1000 N/m stretched initially by 100 mm from the undeformed position. The work required to stretch in another 100 mm is

(A) 5 Nm (B) 7 Nm
(C) 10 Nm (D) 15 Nm

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PART-B
(AE: AUTOMOBILE ENGINEERING)
SECTION –I

Each question carries one mark each. **(20 × 1 = 20)**

46. In case of SI engine to have the best thermal efficiency the fuel air mixture ratio should be

(A) lean (B) rich

(C) may be lean or rich (D) chemically correct

47. Petrol commercially available in India for Indian passenger cars has octane number is in the range :

(A) 40 to 60 (B) 50 to 60

(C) 80 to 85 (D) 95 to 100

48. _____ is the basic requirement of a good combustion chamber.

(A) Low volumetric efficiency

(B) High compression ratio

(C) Low compression ratio

(D) High power output and high thermal efficiency

49. The exhaust valve of an engine is _____ inside in comparison to the inlet valve.

(A) smaller (B) bigger

(C) same (D) varies from design to design

50. The use of tetraethyl lead in gasoline is being generally discontinued since its presence

(A) decreases the engine speed (B) blocks the catalytic converter

(C) makes the fuel costly (D) bad odour

51. Petrol engines are adjusted to give minimum brake specific fuel consumption at

(A) no load (B) 20 to 30% of full load

(C) above 70% of full load (D) near full load

52. The drive from the gear box to the rare axel is taken by

(A) Clutch (B) Universal joint

(C) Propeller shaft (D) Differential gear

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53. The ratio of the actual damping coefficient to the critical damping coefficient is known as

(A) Damping factor (B) Critical damping coefficient

(C) Logarithmic decrement (D) Magnification factor

54. For which of the following types of damping are motor cycle shock absorbers generally designed ?

(A) Critical damping (B) Partial damping

(C) Resonant damping (D) Large damping

55. A simple spring mass vibrating system has a natural frequency of N if the spring stiffness is halved and the mass is doubled, then the natural frequency will become

(A) N/2 (B) 2N

(C) 4N (D) 8N

56. A reed type tachometer uses the principle of

(A) Torsional vibration (B) Longitudinal vibration

(C) Transverse vibration (D) Damped free vibration

57. Excessive piston clearance causes

(A) Piston slap (B) Piston seizure

(C) Scuffing (D) All the above

58. The connecting rod is equally strong in buckling if

(A) $I_{xx} = 4\, I_{yy}$ (B) $K_{xx}^2 = K_{yy}^2$

(C) Both (A) and (B) (D) None of the above

59. Connecting rod is designed as

(A) Column (B) Beam

(C) Strut (D) Tension member

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60. By which of the following instrument the temperature of hot moving body can be measured ?

(A) Resistance thermometer (B) Radiation pyrometer

(C) Optical pyrometer (D) None of the above

61. In limits and fits, the term allowance usually refers to

(A) difference between maximum size and minimum size of the shaft.

(B) difference between maximum size and minimum size of the hole.

(C) maximum clearance between shaft and hole.

(D) minimum clearance between shaft and hole.

62. The transducer in a measurement system is the

(A) Signal conditioning device (B) Input element

(C) Output element (D) Processing device

63. For thermocouple, which of the following statements is incorrect ?

(A) Their calibration does not change with time or temperature.

(B) They read r.m.s value.

(C) They are incapable of standing any overloads.

(D) If calibrated on DC, they cannot be used for AC signals.

64. Raster CRT eliminates

(A) Flicker and slow update (B) Flicker only

(C) Slow update only (D) Has no effect

65. In CIM, manufacturing engineering requires activities like

(A) NC programming (B) Simulation

(C) Marketing program (D) All of the above

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SECTION – II

Each question carries two marks. **(10 × 2 = 20)**

66. Match List I with List II and select the correct answer from the codes given below the lists :

	List – I		**List – II**
I	Gas Turbine	1.	Constant volume heat addition and constant volume heat rejection.
II	Petrol Engine	2.	Constant pressure heat addition and constant volume heat rejection.
III	Stirling Engine	3.	Constant pressure heat addition and constant pressure heat rejection.
IV	Diesel Engine	4.	Heat addition of constant volume followed by heat addition at constant temperature.

Codes :

	I	II	III	IV
(A)	3	1	4	2
(B)	2	3	1	4
(C)	1	2	3	4
(D)	4	1	2	3

67. Which one of the following engines will have heavier flywheel than the remaining one ?

(A) 40 HP four stroke petrol engine running at 1500 rpm
(B) 40 HP two stroke petrol engine running at 1500 rpm
(C) 40 HP two stroke diesel engine running at 750 rpm
(D) 40 HP four stroke diesel engine running at 750 rpm

68. A fuel represented by the formula C_8H_{16} is used in an IC engine. Given that the molecular weight of air is 29 and that 4.76 kmols of air contains 1 kmol of oxygen and 3.76 kmols of nitrogen, the air/fuel ratio by mass is

(A) 11.47 (B) 12.78
(C) 14.79 (D) 19.52

69. When $\frac{\omega}{\omega_n} > \sqrt{2}$ then the transmissibility will be

(A) > 1 (B) < 1
(C) Equal to 1 (D) None of the above

70. A mass of 1 kg is attached to the end of a spring with stiffness 0.7 N/mm. The critical damping coefficient of this system will be

(A) 1.40 Ns/m (B) 18.522 Ns/m
(C) 52.92 Ns/m (D) 529.2 Ns/m

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71. Match List I with List II and select the correct answer from the codes given below the lists :

	List – I		**List – II**
I	Taly Surf	1	T Slots
II	Telescopic gauge	2	Flatness
III	Transfer calipers	3	Internal diameter
IV	Auto collimator	4	Roughness

Codes :

	I	II	III	IV
(A)	1	2	3	4
(B)	4	3	1	2
(C)	4	3	2	1
(D)	3	4	1	2

72. Allowance in fits and limits 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

73. Consider the following statement :

(I) The performance of an SI engine can be improved by increasing the compression ratio.
(II) Fuels of higher octane number can be employed at higher compression ratio.

Of these statements

(A) Both(I) and (II) are true
(B) Both (I) and (II) are false
(C) (I) is true and (II) is false
(D) (I) is false and (II) is true

74. Match List I with List II and select the correct answer from the codes given below the lists :

	List – I		**List – II**
I	Inertia force	1	C dy/dt
II	Spring force	2	M d^2y/dt^2
III	Damping force	3	M $\omega^2 R$
IV	Centrifugal force	4	ky

Codes

	I	II	III	IV
(A)	1	3	2	4
(B)	2	4	1	3
(C)	2	1	4	3
(D)	1	2	3	4

75. What is the use of a profilometer ?

(A) To measure surface roughness
(B) To measure taper
(C) To measure profile of the thread
(D) None of the above

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PART – B
(MC: MECHANICAL ENGINEERING)
SECTION – I

Each question carries one mark. **(20 × 1 = 20)**

46. Which of the following is a case of steady state heat transfer ?

(A) IC Engine (B) Air preheaters

(C) Heating of building in winter (D) None of the above

47. Thermal conductivity of Air at room temperature in k cal/m.hr °C is of the order of

(A) 0.002 (B) 0.02

(C) 0.01 (D) 0.1

48. Nusselt number is expressed by

(A) $\frac{\text{inside diameter of tube}}{\text{equivalent thickness of film}}$

(B) $\frac{\text{thermal conductivity}}{\text{equivalent thickness of film}}$

(C) $\frac{\text{specific heat} \times \text{visocity}}{\text{thermal conductivity}}$

(D) $\frac{\text{coefficient of heat transfer} \times \text{inside diameter}}{\text{thermal conductivity}}$

49. Planck's law holds good for

(A) Black bodies (B) Polished bodies

(C) All coloured bodies (D) All of the above

50. Break even analysis shows profit when

(A) Sales revenue > total cost (B) Sales revenue = total cost

(C) Sales revenue < total cost (D) Variable cost < fixed cost

51. The basic difference between PERT and CPM is that

(A) PERT deals with events and CPM with activities

(B) Critical path is determined in PERT only

(C) PERT is used in workshops and CPM in plants

(D) Guessed times are used in PERT and evaluated times in CPM

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52. Emergency rush over can be pushed more effectively in

(A) Job production
(B) Automatic production
(C) Continuous production
(D) Intermittent production

53. A rupee received one year hence is not the equivalent of a rupee received today, because the use of money has a value. This is principle under

(A) Pay – back method
(B) Average return on investment method
(C) Present value method
(D) Cost accounting value method

54. Critical path on PERT/CPM chart is obtained by joining the events having

(A) Maximum slack
(B) Minimum slack
(C) Average slack
(D) No slack

55. An event is indicated on the network by

(A) Straight line
(B) A number enclosed in a circle or a square
(C) A dotted line
(D) An arrow

56. Surface tension is caused by the force of _____ at the free surface.

(A) Cohesion
(B) Adhesion
(C) Both (A) & (B)
(D) None of the above

57. Flow between parallel plates of infinite extent is an example of

(A) One – dimensional flow
(B) Two – dimensional flow
(C) Three – dimensional flow
(D) Compressible flow

58. The laminar / viscous flow is characterized by Reynold's no. which is

(A) less than the critical value
(B) equal to critical value
(C) more than the critical value
(D) none of the above

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59. A Kaplan turbine is

(A) An inward flow impulse turbine

(B) Low head mixed flow turbine

(C) High speed axial flow turbine

(D) High head mixed flow turbine

60. A rotameter is used to measure which of the following ?

(A) Specific gravity of liquid (B) Velocity of liquids

(C) Pressure of gases (D) All of the above

61. A _____ is used to measure percentage of silica in water.

(A) Photometer (B) Conductivity cell

(C) Calorimeter (D) None of the above

62. Load cell is essentially a

(A) Photovoltaic (B) Strain gauge

(C) Thermistor (D) None of the above

63. _____ is suitable for measuring the temperature of red hot moving material. (like molten steel or cast iron)

(A) Thermocouple (B) Gas thermometer

(C) Radiation pyrometer (D) Thermistor

64. Which of the following is not considered a method of input control in a CAD system ?

(A) Programmable function bar (B) Joystick

(C) Plotter (D) Touch terminal

65. Which of the following is responsible for coordinating various operations using timing signals ?

(A) Arithmetic logic unit (B) Control unit

(C) Memory unit (D) Input/output unit

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SECTION – II

Each question carries two marks. **(10 × 2 = 20)**

66. Two balls of same material and finish have their diameter in the ratio of 2:1 and both are heated to same temperature and allowed to cool by radiation. Rate of cooling by big ball as compared to smaller one will be in the ratio of

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

(C) 1:2 (D) 4:1

67. 40% of incident radiant energy on the surface of a thermally transparent body is reflected back. If the transmissivity of the body be 0.15, then the emissivity of surface is

(A) 0.45 (B) 0.55

(C) 0.40 (D) 0.75

68. The number of observation to be made on a machine for work sampling study for an absolute accuracy of 4% with 95% confident level, (if probability of machine being busy is P%), is equal to

(A) $\frac{4P(100-P)}{A^2}$ (B) $\frac{P(100-A)}{A^2}$

(C) $\frac{9P(100-P)}{A^2}$ (D) $\frac{2P(100-P)}{A^2}$

69. If t_o, t_m and t_p represent the optimistic, most probable and pessimistic time for a project, then by probability analysis, most probable expected time t_c =

(A) $\frac{t_o + 4t_m + t_p}{6}$ (B) $\frac{t_o + 6t_m + t_p}{6}$

(C) $\frac{t_o + 2t_m + t_p}{6}$ (D) $\frac{2t_o + 4t_m + t_p}{6}$

70. According to Halsey 50 – 50 plan, if H = hourly rate, A = actual time and S = standard time, then wages will be

(A) HA (B) $HA + \left(\frac{S-A}{S}\right)HA$

(C) $HA + \left(\frac{(S-A)H}{2}\right)$ (D) $H(S-A) + \left(\frac{HA}{2}\right)$

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71. Match List – I with List – II and select the correct answer using the codes given below the lists :

List – I		List – II	
(a)	Kaplan turbine	(1)	High values of speed and specific
(b)	Pelton wheel	(2)	Work under atmospheric pressure
(c)	Draft tube	(3)	High part load efficiency
(d)	Axial flow turbine	(4)	Pressure head recovery

Codes :

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

72. Suppose X is a normal random variable with mean 0 and variance 4. The mean of the absolute value of X is

(A) $\frac{1}{\sqrt{2\pi}}$ (B) $\frac{2\sqrt{2}}{\sqrt{\pi}}$

(C) $\frac{2\sqrt{2}}{\pi}$ (D) $\frac{2}{\sqrt{\pi}}$

73. A machine is purchased for ₹ 32,000, and its assumed life is 20 years. The scrap value at the end of its life is ₹ 8,000. If the depreciation is charged by the diminishing balance method, then the percentage reduction in its value, at the end of the first year is

(A) 6.7% (B) 7.1% (C) 7.2% (D) 7.6%

74. The lead time consumption is 500 units. The annual consumption is 8000 units. The company has a policy of EOQ ordering and maintenance of 200 units as safety stock. The recorder point (ROP) is

(A) 500 units (B) 700 units

(C) 200 units (D) None of these

75. A centrifugal pump was manufactured to couple directly to a 15 HP electric motor running at 1950 rpm delivering 50 litres per minute against a total head of 20 m. It is desired to replace the motor by a diesel engine with 100 rpm and couple it directly to the pump. The head developed by the pump is likely to be

(A) 41.4 m (B) 29.6 m

(C) 20 m (D) 9.5 m

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PART-B
IPE: INDUSTRIAL PRODUCTION & ENGINEERING
SECTION-I

Each question carries one mark. **(20 × 1 = 20)**

46. The number of therblig symbols is
(A) 20 (B) 15 (C) 18 (D) 16

47. The technique for synthesizing operation times form standard time data for basic motions is called _____system
(A) PTS (B) MTM
(C) TMU (D) None of the above

48. The surface roughness on a drawing is represented by
(A) Circles (B) Squares
(C) Zig-Zag lines (D) Triangles

49. Expressing a dimension as $18.3^{+0.00}_{-0.02}$ mm is the case of
(A) Unilateral tolerance (B) Bilateral tolerance
(C) Limiting dimensions (D) None of the above

50. In an n × n matrix of an assignment problem, the optimality is reached when the minimum number of straight line scoring all the zero is
(A) n^2 (B) n/2 (C) n (D) 2n

51. Fair game value of a game is
(A) Positive or negative (B) Zero
(C) Positive (D) Negative

52. In PERT analysis a critical activity has
(A) Maximum float (B) Zero float
(C) Maximum cost (D) Minimum cost

53. A process is said to be controlled with standard values of mean = 18 and the standard deviation is = 4. The sample size is 9. The control limits for x – chart are
(A) 18 ± 9 (B) 18 ± 6 (C) 18 ± 4 (D) 18 ± 3

54. 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

55. 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

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56. In a Direct Beam Refresh tube type of display unit
(A) There is no staircasing
(B) A cathode-ray tube is made use of
(C) There is no colour capability
(D) Selective erasure is possible

57. Following is not a Non Destructive Testing Method :
(A) Magnetic particle inspection method
(B) Ultrasonic testing method
(C) Leak test method
(D) Nickbreak test method

58. SIMO charts are used in
(A) Method study
(B) Micro motion study
(C) Process analysis
(D) Layout analysis

59. $\bar{X}$ and R charts are used for
(A) Production control
(B) Cost control
(C) Process control
(D) Material control

60. Which of the following operations is called internal turning ?
(A) Drilling
(B) Reaming
(C) Boring
(D) Counter boring

61. In reaming process
(A) Metal removal rate is high
(B) High surface finish is obtained
(C) High form accuracy is obtained
(D) High dimensional accuracy is obtained

62. In forging operation, work piece is usually subjected to
(A) Compressive stress
(B) Tensile stress
(C) Shear stress
(D) Bending stress

63. If R be roll radius and μ, the coefficient of friction between contact surfaces, then draft can be expressed as
(A) μR^2 (B) $\mu^2 R$ (C) $\mu^3 R$ (D) μR^3

64. Roll piercing is used to produce
(A) Cooking pot
(B) Seamless tube
(C) Railroad rail
(D) Crank shaft

65. Turning produces
(A) Square shape
(B) Triangular shape
(C) Cylindrical shape
(D) All of the above

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SECTION - II

Each question carries two marks. **(10 × 2 = 20)**

66. For obtaining a cup of diameter 25 mm and height 15 mm by drawing, the size of the round blank should be approximately

(A) 42 mm (B) 44 mm

(C) 46 mm (D) 48 mm

67. To drill a 10 mm diameter hole through a 20 mm thick MS plate with a drill bit running at 300 rpm and a feed of 0.25 mm/revolution. Time taken will be

(A) 8 secs (B) 16 secs

(C) 24 secs (D) 32 secs

68. 3 – 2– 1 method of location in jig or fixture would collectively restrict. The work piece in n degrees of freedom, where the value of n is

(A) 6 (B) 8

(C) 9 (D) 1

69. Match List–I with List–II and select the correct answer using the codes given below the lists :

	List – I		**List – II**
A.	Mechanical comparator	1.	Variable inductance
B.	Pneumatic comparator	2.	Dial indicator
C.	Electrical comparator	3.	Higher accuracy
D.	Optical comparator	4.	Air pressure

Codes :

	A	B	C	D
(A)	3	4	1	2
(B)	2	4	1	3
(C)	4	2	1	3
(D)	1	4	3	2

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70. A PERT activity has an optimistic time of 12 days, pessimistic time of 60 days and expected time is 28 days. The most likely time of an activity is

(A) 24 days (B) 16 days

(C) 17 days (D) 15 days

71. Maximized value for the objective function $Z = 5x_2 - x_1$

Subject to constraints $2x_1 + 5x_2 < 80$

$x_1 + x_2 < 20$

$x_1, x_2 > 0$ is

(A) 40 (B) 60

(C) 80 (D) 100

72. An air conditioner was purchased for ₹ 22,000/- and has a life of 10 years. The salvage value is ₹ 4,000/-. The book value at the end of 8 years, by straight line depreciation method is

(A) ₹10,000 (B) ₹ 7,600

(C) ₹ 9,200 (D) ₹ 8,400

73. If A_2 is 0.577, $R = 2$, $\bar{X} = 1.0$, then LCL of the $\bar{x}$-chart is

(A) 1 (B) 0.577

(C) 0.2 (D) 0

74. The sub-group size is 20. The standard deviation of the sub-groups is 5, 7, 6, 4, 6, 7, 5, 4, 5, 7. The upper control limit for a sigma chart is

(A) 1.856 (B) 4.856

(C) 6.344 (D) 8.344

75. In point to point control NC Machine, the slide is positioned by an integrally mounted stepper motor drive. If the motor specification is 1° per 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

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PART-B
IEM : INDUSTRIAL ENGINEERING AND MANAGEMENT
SECTION-I

Each question carries one mark. **(20 × 1 = 20)**

46. An automobile industry is an example of

(A) Military organization (B) Functional organization

(C) Line and staff organization (D) None of the above

47. Inspection is a tool of

(A) Quality control (B) PPC

(C) Work-study (D) None of the above

48. The SQC methods are based on the theory of

(A) Relativity (B) Efficiency

(C) Productivity (D) Probability

49. The Father of Scientific Management is

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

(C) Henry Fayol (D) Russell Roff

50. Most accurate instrument is

(A) Steel rule (B) Micrometer screw gauge

(C) Vernier calliper (D) Optical projector

51. The following type of gauges has gauging sections combined on one end.

(A) Combination gauge (B) Limit gauge

(C) Go and No go gauge (D) Progressive gauge

52. The axis of movement of a Robot may include

(A) X-Y Coordinate motion (B) Wrist rotation

(C) Elbow rotation (D) All of the above

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53. The APT (Automatically Programmed Tool) language is used with

(A) Drafting system
(B) NC machines
(C) Programmable controllers
(D) Large automation systems

54. In Assignment model

(A) Degeneracy is always present in all the problems
(B) Number of resources is equal to number of jobs
(C) Only one unit from the i^{th} source can be assigned to any of its destination
(D) All of the above

55. Optimality is reached when all index values are

(A) Zero
(B) Negative
(C) Positive
(D) None of the above

56. A small allowance of time which may be included in a standard time to meet legitimate and expected items of work or delays is called

(A) Policy allowance
(B) Contingency allowance
(C) Special allowance
(D) Interference allowance

57. A process chart in which the activities of worker's hands (or limbs) are recorded in their relationship to one another is called

(A) Out line process chart
(B) Control chart
(C) Two – handed process chart
(D) Travel chart

58. 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

59. The cost of inventory does not include

(A) Ordering cost
(B) Material cost
(C) Carrying cost
(D) Shortage cost

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60. In MTM one TMU is equal to

(A) 0.0006 minute
(B) 0.0008 minute
(C) 0.0005 minute
(D) 0.0069 minute

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

(A) Normal distribution
(B) Binomial distribution
(C) Beta distribution
(D) Gamma distribution

62. A data base models the data, so that it is

(A) Appropriate for application
(B) Independent of application program
(C) Optimized for most frequent applications
(D) Optimized for all applications

63. The time which results in the least possible direct cost of an activity is known as

(A) Normal time
(B) Slow time
(C) Crash time
(D) Standard time

64. The system of codification which consists of 10 digits of numerical code is called

(A) Brich system
(B) Periphery system
(C) Kodak system
(D) Centralized system

65. The micro motion study involves how many number of fundamental hand motions ?

(A) 12
(B) 14
(C) 15
(D) 16

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SECTION-II

Each question carries two marks. **(10 × 2 = 20)**

66. If A_2 is 0.577, R = 2 $\bar{x}$ = 1.0, then LCL of the $\bar{x}$ - chart is

(A) 1 (B) 0.577

(C) 0.2 (D) 0

67. Consider the following LPP: Maximize $Z = 3x_1 + 2x_2$

Subject to constraints $x_1 \leq 4$

$$x_2 \leq 6$$

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

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

(A) The LPP has a unique optimal solution

(B) The LPP is unbounded

(C) The LPP is bounded

(D) The LPP has multiple optimal solutions

68. The annual demand for an item is 4000 units. The ordering cost per order is ₹ 150, the inventory holding cost based on average inventory is 20%. The cost per unit is ₹ 5 and the shortage cost based on maximum inventory is 10 paisa per unit per year. The EOQ will be

(A) 10 units (B) 100 units

(C) 1000 units (D) 10,000 units

69. A fit is specified as 2.5 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 microns is

(A) – 7 (B) 7

(C) 73 (D) 106

70. 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 reorder level for 95% service level is

(A) 236 (B) 206

(C) 212 (D) 218

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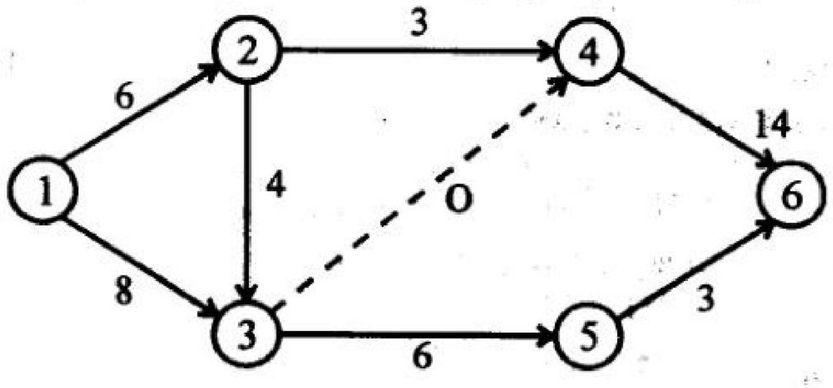
71. For the network shown in the figure, the variance along the critical path is 9. The probability of completion of the project in 24 days is



(A) 68.2%
(B) 84.1%
(C) 95.4%
(D) 50%

72. 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

73. 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° per 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

74. An operator manufactures 75 jobs in 8 hrs. If this time includes the time for setting his machine, calculate the operator's efficiency, standard setting time is 49 units and production time per piece is 10 minutes.

(A) 115.5%
(B) 164.6%
(C) 184.7%
(D) 224.8%

75. A process is to be controlled with standard values of mean = 20 and the standard deviation = 6. The sample size is 9. The control limits for $\bar{x}$-chart are

(A) 20 ± 9
(B) 20 ± 4
(C) 20 ± 6
(D) 20 ± 3

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PART – B
MSE: MANUFACTURING SCIENCE AND ENGINEERING
SECTION – I

Each question carries one mark. **(20 × 1 = 20)**

46. Carburizing flame is not suitable for steel, because
(A) it weakens the joint. (B) it makes the joint brittle.
(C) it is not economical. (D) melting point of steel is very high.

47. Which of the following operations is called internal turning ?
(A) Drilling (B) Reaming
(C) Boring (D) Counter boring

48. Enlarging an existing circular hole with a rotating single point cutting tool is called
(A) Boring (B) Reaming
(C) Drilling (D) Counter boring

49. Name the process that uses single point cutting tool
(A) Drilling (B) Milling
(C) Turning (D) Grinding

50. A group of NC words character or digits used to describe one instruction in a part program is called
(A) Block (B) Line
(C) Buffer (D) None of the above

51. The code G00 stands for
(A) Rapid traverse (B) Linear interpolation
(C) Cutter compensation (D) None of the above

52. If A_0 and A_f are the original and final cross-section areas of stock during bar drawing, then the area reduction is expressed as
(A) $A_0 / (A_0 - A_f)$ (B) $(A_0 - A_f) / A_0$
(C) A_0 / A_f (D) A_f / A_0

53. Which of the following is the correct temperature range for hot extrusion of aluminium ?
(A) 300 – 340 °C (B) 350 – 400 °C
(C) 430 – 480 °C (D) 550 – 650 °C

54. The forging defect due to hindrance to smooth flow of metal in the component called 'Lap' occurs because
(A) the corner radius provided is too large.
(B) the corner radius provided is too small.
(C) draft is not provided.
(D) the shrinkage allowance is inadequate.

55. Deep drawing can be used to produce
(A) Cooking pots (B) Beverage cans
(C) Automobile fuel tanks (D) Connecting rods

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56. A moving mandrel is used in
(A) Wire drawing
(B) Tube drawing
(C) Metal cutting
(D) Forging

57. In case of metallic arc welding the electric current may be
(A) AC only
(B) DC only
(C) AC and DC only
(D) None of the above

58. Which of the following materials has best weldability ?
(A) High carbon steel
(B) Low carbon steel
(C) High speed steel
(D) Cast iron

59. Piezoelectric crystal possess the ability to convert
(A) Electrical energy into mechanical energy
(B) Mechanical energy into electrical energy
(C) Strain energy into electrical energy
(D) All the above

60. Fluid flow in an open channel can be measured by
(A) Manometer
(B) Nozzle
(C) Orifice
(D) None of these

61. The main factor responsible for decrease in tool life is
(A) Cutting speed
(B) Feed
(C) Depth of cut
(D) None of the above

62. The CLA value is used for the measurement of
(A) Surface dimensions
(B) Bend of the tool edge
(C) Hardness of tool
(D) Surface roughness

63. During metal cutting operations continuous chips are produced while machining
(A) Ductile material
(B) Brittle material
(C) Hard material
(D) Soft material

64. In which of the following configurations the robot body is a vertical column that swivels about a vertical axis ?
(A) Polar coordinate configuration
(B) Cylindrical coordinate configuration
(C) Joint arm configuration
(D) None of the above

65. The standard deviation is
(A) An average deviation
(B) Same as median
(C) One half of mode
(D) A measure of dispersion

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SECTION – II

Each question carries two marks. **(10 × 2 = 20)**

66. In a tool life test, doubling the cutting speed reduces the tool life to $1/8^{th}$ of the original. The Taylor's tool life index is

(A) 1/2 (B) 1/3

(C) 1/4 (D) 1/8

67. The spindle speeds in a machine tool are 160, 229, 328, 496 ..... The next higher speed will be

(A) 642 (B) 660

(C) 671 (D) 695

68. A cup of 10 cm height and 5 cm diameter is to be made from a steel metal of 2 mm thickness. The number of reductions necessary will be

(A) One (B) Two

(C) Three (D) Four

69. The steps followed for development of Linear Programming model are

i State the problem in the form of a Linear Programming model

ii Determine the decision variables

iii Write the objective function

iv Develop equations for the constraints

The correct order is

(A) i, ii, iii, iv (B) ii, i, iii, iv

(C) iv, i, ii, iii (D) iv, iii, ii, i

70. A PERT activity has an optimistic time of 3 days, pessimistic time of 15 days and expected time of 7 days. The most likely time of the activity is

(A) 5 days (B) 6 days

(C) 7 days (D) 9 days

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71. In a typical metal cutting operation, using a cutting tool of positive rake of 10°, it was observed that the shear angle was 20°. The friction angle is

(A) 45° (B) 30°

(C) 60° (D) 40°

72. 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

73. The allowance in an assembly is 0.03 mm and the shaft tolerance is 0.02 mm. The dimensions are specified as per 'Basic hole system'. The upper and lower limit of the hole are 25.02 and 25.00 mm and the lower limit of the shaft is 24.95. The upper limit of the shaft is

(A) 24.90 mm (B) 24.95 mm

(C) 24.97 mm (D) 25.00 mm

74. In an orthogonal cutting operation, chip thickness is 0.2 and the tool rake is 0°. Then, the shear angle tan φ is

(A) 0.6 (B) 0.8

(C) 0.2 (D) 1.0

75. The value of cutting speed in a drilling operation to drill a hole of 10 mm at 1000 rpm is

(A) 31.42 m/min (B) 42.0 m/min

(C) 21.36 m/min (D) None of the above

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SEAL

A-1

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