SEAL

Booklet Serial No.

2200837

Booklet Series

A

05/EFC/M-2025-05(A)

Question Booklet

MECHANICAL ENGINEERING

PAPER – II

Candidate's Roll Number

Time Allowed : 2 Hours

Maximum Marks : 300

Read the following instructions carefully before you begin to answer the questions.

IMPORTANT INSTRUCTIONS

1. This Question Booklet contains **100** questions in all.
2. **All** questions carry equal marks.
3. An Answer Sheet has been supplied inside the question booklet to mark the answers. **You must write your Roll Number and encode it and write other particulars in the space provided in the Answer Sheet, failing which your Answer Sheet will not be evaluated.**
4. **Immediately after commencement of the examination, you should check up your Question Booklet and attached answer sheet and ensure that the Question Booklet Series is printed on the top left-hand corner of the Booklet and the series encoded in answer sheet are same. Also please check that the Booklet contains 20 printed pages including two pages (Page Nos. 19 and 20) for Rough Work and no page or question is missing or unprinted or torn or repeated or question booklet and answer sheet have different series. If you find any defect in this Booklet and attached answer sheet, get it replaced immediately by a complete Booklet with OMR sheet of the same series.**
5. You must write your Roll Number in the space provided on the top of this page. Do not write anything else on the Question Booklet.
6. Questions and their responses are printed in English version in this Booklet. Each question comprises of **four** responses – (A), (B), (C) and (D). You are to select ONLY ONE correct response and mark it in your Answer Sheet. In case you feel that there are more than one correct response, mark the response which you consider the best. In any case choose ONLY ONE response for each question.
7. In the Answer Sheet, there are **four** circles – Ⓐ, Ⓑ, Ⓒ and Ⓓ against each question. To answer the questions, you are to mark with **Black/Blue ink ballpoint pen ONLY ONE circle** of your choice for each question. Select only one response for each question and mark it in your Answer Sheet. If you mark more than one circle for one question, the answer will be treated as wrong. **Use Black/Blue ink ballpoint pen only to mark the answer in the Answer Sheet. Any erasure or change is not allowed.**
8. For each question for which a wrong answer/more than one answer has been given by the candidates, **one third (1/3)** of the marks assigned to that question will be deducted as penalty.
9. You should not remove or tear off any sheet from the Question Booklet. You are not allowed to take this Question Booklet and the Answer Sheet out of the Examination Hall during the examination. **After the examination has concluded, you must hand over your Answer Sheet to the Invigilator.** Thereafter, you are permitted to take away the Question Booklet with you.
10. Failure to comply with any of the above instructions will render you liable to such action or penalty as the Commission may decide at their discretion.
11. Candidates must assure before leaving the Examination Hall that their Answer Sheets will be kept in Self Adhesive LDPE Bag and completely packed/sealed in their presence.

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1. Brittle materials are

(A) Strong in compression and weak in tension

(B) Strong in tension and weak in compression

(C) Strong in tension and strong in shear

(D) Strong in compression and strong in tension

2. During compression test, a metallic bar 50 mm × 50 mm cross-section was subjected to an axial compressive load. Measurement showed that there was 0.04 mm increase in thickness and 0.5 mm contraction in length over a gauge length of 200 mm. The value of Poisson's ratio is

(A) 0.25

(B) 0.30

(C) 0.32

(D) 0.36

3. A steel bar of volume 240×10^4 mm^3 is subjected to a gradually applied load in such a way that tensile stress induced in the bar becomes 100 N/mm^2. Modulus of elasticity for bar is 2×10^5 N/mm^2. The strain energy stored in the bar is

(A) 58000 Nm

(B) 56350 Nm

(C) 56100 Nm

(D) 60000 Nm

4. The moment of inertia of a triangular lamina of base b and height h about its centroidal axis is

(A) $\frac{bh^3}{36}$

(B) $\frac{bh^3}{4}$

(C) $\frac{bh^3}{12}$

(D) $\frac{bh^3}{6}$

5. A steel bar (modulus of elasticity 2×10^5 N/mm^2) is 100 mm wide and 10 mm thick. This bar can be bent if the maximum allowable stress 500 N/mm^2. Then the least radius of the bend will be

(A) 2100 mm

(B) 2050 mm

(C) 2010 mm

(D) 1995 mm

6. A simply supported beam of length l carries a concentrated load W at the middle. The maximum bending moment in this beam will be

(A) $\frac{Wl}{4}$

(B) $\frac{Wl}{3}$

(C) $\frac{Wl}{2}$

(D) $\frac{Wl}{8}$

7. A single rivetted lap joint is designed to transmit a force of 5 kN and the stear stress acting on the rivet at the junction where the rivet tends to shear is 40 N/mm^2. The area being sheared is

(A) 125 mm^2

(B) 120 mm^2

(C) 130 mm^2

(D) 135 mm^2

8. For wire drawing work, the material should be

(A) tough

(B) ductile

(C) malleable

(D) hard

9. The product from the blast furnace is called

(A) cast iron

(B) wrought iron

(C) pig iron

(D) steel

10. Babbit metal is a

(A) copper base alloy

(B) tin base alloy

(C) nickel base alloy

(D) zinc base alloy

11. Mild steel belongs to category of

(A) zero carbon steel

(B) low carbon steel

(C) medium carbon steel

(D) high carbon steel

12. In high speed steels, the alloying element with maximum percentage is

(A) vanadium

(B) molybdenum

(C) tungsten

(D) silicon

13. Normalised steels are

(A) harder and stronger than full annealed steels

(B) less hard than full annealed steels

(C) known for their dendritic structure

(D) full of strains and unfit for casting

14. In powder metallurgy

(A) the composition of product cannot be easily controlled

(B) the parts manufactured have very good ductility

(C) there is minimum loss of material

(D) complex shapes cannot be produced

15. The total number of instantaneous centres of a mechanism having n links is

(A) n

(B) $\frac{3}{2}n$

(C) $2n$

(D) $\frac{n(n-1)}{2}$

16. A flywheel absorbs 20 kJ of energy when its speed increases from 210 rpm to 220 rpm. Its kinetic energy at 258 rpm will be

(A) 307.5 kJ

(B) 309.6 kJ

(C) 285.5 kJ

(D) 320.5 kJ

17. A governor readily responds to a very small change of speed and the movement of sleeve is large. The governor is

(A) sensitive

(B) stable

(C) isochronous

(D) both stable and isochronous

18. When two pulleys are connected by a cross belt drive, then?

(A) both pulleys rotate in the same direction

(B) power transmitted is less as compared to open belt drive

(C) both pulleys rotate in the opposite direction

(D) the angle of wrap is less compared to open belt drive

19. Cone clutch

(A) has the advantage that normal force on contact surface is increased

(B) has high cone angle

(C) can be easily disengaged

(D) is not obsolete

20. In a mass spring system, if the mass is doubled and spring stiffness is halved, the natural frequency is

(A) quadrupled

(B) unchanged

(C) doubled

(D) halved

21. A person rides on a bicycle and starts travelling at 3 m/s on a levelled road. The total mass of person with bicycle is 120 kg. The diameter of rear wheel is 800 mm. A brake is applied to the rear wheel such that normal reaction at the mid point of brake is 80 N. The coefficient of friction is 0.05. The distance covered by bicycle before coming to rest will be

(A) 135 m

(B) 126 m

(C) 130 m

(D) 138 m

22. Taper tuning operation is performed on a cylindrical metallic bar of large diameter D and length L to produce a conical surface with small diameter d. If half of taper angle is α, then

(A) $\tan\alpha = \dfrac{\left[D - \left(\dfrac{d}{2}\right)\right]}{L}$

(B) $\tan\alpha = \dfrac{D-d}{2L}$

(C) $\tan\alpha = \dfrac{2(D-d)}{L}$

(D) $\tan\alpha = \dfrac{\left[\left(\dfrac{D}{2}\right) - d\right]}{L}$

23. There is a machine tool in which metal is removed by means of revolving cutter with many teeth. Each tooth has a cutting edge which removes metal from a work piece. Such a machine is

(A) drilling machine

(B) lathe machine

(C) shaper

(D) milling machine

24. Hobbing

(A) cannot be used for machining internal gears

(B) machine cannot accomodate long shafts

(C) is not applicable to nonmetallic materials

(D) machine gives low production rate

25. In lathe, the tool advances into workpiece during one revolution of headstock spindle. This is known as

(A) depth of cut

(B) feed

(C) tool cut

(D) previous cut

26. The grinding

(A) is not a metal cutting operation

(B) action does not depend on characteristics of grinding wheel

(C) takes long time of contact between the chip and an abrasive grain

(D) operation is intermittent in nature and produces discontinuous chips

27. Aluminum oxide is

(A) a natural abrasive

(B) an artificial abrasive

(C) not tough and can be easily fractured

(D) not suitable for grinding materials of high tensile strength

28. Super finishing

(A) does not differ from other abrasive finishing methods

(B) initiates metallurgical alteration

(C) is an abrading process which is efficient in surface refining

(D) is a dimension changing process

29. The work output and heat input involved by a system in process A are 20 kJ and 15 kJ respectively. Another process B between the same end conditions involves a heat input of 10 kJ. The change in internal energy and work done during process B are

(A) – 5 kJ, 15 kJ respectively

(B) 15 kJ, 10 kJ respectively

(C) – 10 kJ, 15 kJ respectively

(D) – 5 kJ, –15 kJ respectively

30. Mollier diagram is a plot of

(A) temperature – entropy

(B) enthalpy – entropy

(C) pressure – enthalpy

(D) pressure – volume

31. Water is used for steam generation. At the critical point, enthalpy of vapourisation is

(A) zero

(B) minimum

(C) maximum

(D) dependent on temperature only

32. Curtis turbine is

(A) single rotor impulse turbine

(B) impulse – reaction turbine

(C) velocity compounded impulse turbine

(D) pressure compounded impulse turbine

33. A closed vessel contains gas at pressure 70 kPa and temperature 305 K. Heat is supplied to the vessel till the gas attains 140 kPa of pressure. The final temperature of gas and work done on or by the gas are

(A) 684 K, 70 kJ respectively

(B) 560 K, 75 kJ respectively

(C) 610 K, Zero respectively

(D) 625 K, 110 kJ respectively

34. A heat engine is supplied with 2700 kJ/min of heat at 900 K. This engine rejects 1200 kJ/min of heat at 400 K. The cycle is

(A) reversible

(B) irreversible

(C) impossible

(D) irreversible and obeys second law of Thermodynamics

35. Entropy is

(A) not a property

(B) path function

(C) point function

(D) less than zero for an isolated system

36. A turbine is supplied with steam at a pressure of 20 bar gauge. After expansion in turbine, the steam passes to a condenser which is maintained at a vacuum of 240 mm of mercury by means of pumps. The barometer reads 750 mm of mercury which is equivalent to 1 bar. The pressure at inlet to turbine and at condenser are respectively

(A) 2000 kPa, 540 mm of mercury

(B) 2100 kPa, 510 mm of mercury

(C) 2200 kPa, 518 mm of mercury

(D) 2110 kPa, 515 mm of mercury

37. A fluid is said to be ideal, if it is

(A) Incompressible and viscous

(B) Compressible and viscous

(C) Incompressible and non viscous

(D) Compressible and non viscous

38. Specific speed of a hydraulic turbine depends on

(A) Speed, power and discharge

(B) Discharge and power only

(C) Speed and head only

(D) Speed, power and head

39. Francis, Kalpan and propeller turbines fall under the category of

(A) Impulse turbine

(B) Reaction turbine

(C) Axial flow turbine

(D) Mixed flow turbine

40. Water is flowing through a pipe under a total supply head of 1560 kPa. The specific weight of water may be taken as 10000 N/m^3. For maximum transmission of power, the loss of head due to friction will be

(A) 48 m

(B) 50.5 m

(C) 52 m

(D) 54 m

41. A single acting reciprocating pump draws water 4 m below the cylinder axis. The accelerating head at the beginning of suction stroke is 4.8 m. The barometer reads 10.3 m of water. The pressure head on the piston at the beginning of suction stroke is

(A) 1.5 m

(B) 1.1 m

(C) 1.7 m

(D) 1.9 m

42. Radiation is incident on a white body. If α is absorptivity, ρ is reflectivity and τ is transmissivity, then for this body

(A) $\tau = 1$

(B) $\rho = 1$

(C) $\alpha = 1$

(D) $\alpha + \tau = 1$

43. A centrifugal pump lifts water to a total head of 42 m at the rate of 50 litres per second. If the overall efficiency of this pump is 60 percent and specific weight of water is $10000\,N/m^3$, then power required to run it is

(A) 35 kW

(B) 30.5 kW

(C) 33 kW

(D) 37 kW

44. A jet of water (cross-sectional area $8\times10^{-3}m^2$) moving with a velocity of $20\frac{m}{s}$ strikes a stationary plate. Considering specific weight of water as $10000\,N/m^3$ and value of g as $10\ m/s^2$, the force on the plate when it is normal to the jet will be

(A) 2.5 kN

(B) 3.2 kN

(C) 3.4 kN

(D) 3.7 kN

45. In abrasive jet machining

(A) jet uses particles suspended in oil

(B) abrasive grains impinge on work surface at very low speed

(C) the abrasive powder used in process can be reused

(D) metal removal rate depends on flow rate and size of abrasive particles

46. Automation

(A) Provides intermittent production of product

(B) Increases productivity

(C) Does not ensure human safety

(D) Increases overall cost

47. A computer controlled machine tool capable of performing a variety of cutting operations on different surfaces and in different orientations on a workpiece is called

(A) machining centre

(B) automatic centre

(C) tool centre

(D) production centre

48. Broaching machine is a

(A) shaping machine tool

(B) automatic machine tool

(C) general purpose machine tool

(D) special purpose machine tool

49. Turret lathe

(A) can hold a number of cutting tools at a time

(B) gives lower rate of production

(C) is unsuitable for combined cuts

(D) is unsuitable for multiple cuts

50. An Internal Combustion engine with mechanical efficiency of 85 percent develops brake power of 34 kW at full load. The friction power will be

(A) 7.5 kW

(B) 5 kW

(C) 6 kW

(D) 7 kW

51. The indicated power of a multicylinder spark ignition engine is determined by

(A) William's line method

(B) Heat balance sheet

(C) Motoring test

(D) Morse test

52. The propulsive efficiency of a jet propulsion system is

(A) $\frac{\text{Thrust developed}}{\text{Rate of change of momentum of working fluid}}$

(B) $\frac{\text{Propulsive work}}{\text{Thrust work}}$

(C) $\frac{\text{Thrust work}}{\text{Propulsive work}}$

(D) $\frac{\text{Propulsive work}}{\text{Kinetic energy of gases}}$

53. Air pollution means

(A) Presence of abnormal contents in air that do not affect usefulness of air

(B) Presence of dust, fumes, smoke, gas-mist and vapour in outdoor atmosphere

(C) Presence of contaminates to a level not injurious to plant life

(D) Presence of contaminants to a level not injurious to animal life

54. Aerosols are

(A) fixed in size

(B) made up of clean water

(C) particulates such as smoke, soot, dust, mist, fog etc.

(D) allotropic form of oxygen

55. Exhaust emission by petrol engine

(A) will not cause air pollution, if combustion is complete

(B) will cause air pollution whether combustion is complete or incomplete

(C) is not influenced by engine design

(D) is unaffected by idling mode of operation

56. Oxides of nitrogen

(A) are absent in the exhaust emission of compression ignition engine

(B) are not acidic

(C) are primary pollutants

(D) are secondary pollutant

57. Global warming is

(A) natural phenomenon

(B) due to presence of large amount of carbon dioxide in atmosphere which causes greater heading of earth's atmosphere and objects

(C) due to presence of ozone layer

(D) due to presence of sun and other planets

58. If in the exhaust emission of a diesel engine black smoke is appearing, then it means

(A) combustion is complete

(B) load on the engine has decreased

(C) carbon particles in the exhaust gas are suspended with bigger soot particles

(D) that there is suspension of intermediate products of combustion with liquid droplets of lubricating oil

59. Spilling of oil from ocean going tankers causes

(A) acid drainage

(B) air pollution

(C) water pollution

(D) no damage to beaches

60. Fossil fuel fired power plants

(A) discharge solid waste in considerable amount

(B) help in maintaining ecological balance

(C) do not release NO_x where x has a value between 1 and 2

(D) do not contribute to global warming

61. In a power plant noise from turbo-alternator, fans and power transformer reaches a level of 118 dB. This noise level is in

(A) loud zone

(B) comfortable zone

(C) uncomfortable zone

(D) peaceful and permissible zone

62. Metrology is

(A) to evaluate newly developed products partially

(B) to maximise the cost of inspection

(C) limited to length measurement

(D) to maintain the accuracy of measurement

63. The longitudinal central line passing through the screw is known as

(A) effective line of screw

(B) major line of screw

(C) axis of screw

(D) root line of screw

64. Square threads are

(A) Suitable for power transmission

(B) Suitable for fastening purpose

(C) Used in low load applications

(D) Easy to manufacture

65. Quality control

(A) is an ordinary method by means of which products of non uniform quality are manufactured

(B) determines what, when, how much to inspect and what steps should be taken so that defectives are not produced

(C) does not aim at prevention of defectives at the very source

(D) is neither preventive nor corrective action

66. Quality is

(A) Closely related to quantity

(B) Closely related to measurement during inspection

(C) Closely related to cost and customer requirement

(D) Fitness for purpose at maximum cost

67. Statistical quality control

(A) is less effective for quality improvement in comparison to 100 percent inspection

(B) is more effective for quality improvement in comparison to 100 percent inspection

(C) ensures inspection at very high cost

(D) does not guarantee quality of products

68. The major tools of statistical quality control are

(A) Frequency distribution and theory of sampling only

(B) Theory of sampling and quality control chart only

(C) Quality control chart and frequency distribution only

(D) Frequency distribution, theory of sampling, quality control chart and special methods (analysis of tolerance, analysis of variation and correlation)

69. The capacity of an engine is expressed by

(A) Its swept volume

(B) Gross weight of vehicle

(C) Its fuel consumptions

(D) Its load carrying capacity

70. A wheel tyre assembly

(A) is mounted on front axle rarely

(B) is not always in contact with road

(C) makes the vehicle mobile

(D) provides sliding motion to vehicle

71. Auto vehicles

(A) are guided vehicles

(B) for driving at high altitude possess supercharges

(C) are never classified on the basis of number of wheels

(D) are designed easy handling only

72. Suspension system in automobiles

(A) increases stress and strain in various components

(B) maximises the effect of road shock

(C) consists of mainly springs and shock absorber

(D) fails to maintain stability in the vehicles

73. A battery charger is equipped with

(A) a rheostat, an ammeter and a voltmeter only

(B) a rheostat and a voltmeter only

(C) a rheostat and an ammeter only

(D) an ammeter and a voltmeter only

74. In automobile, a propeller shaft

(A) is different from drive shaft

(B) is dynamically unbalanced

(C) assembly mainly includes differential gearing and wheels

(D) is connected to universal coupling at its two ends

75. In an automobile the headlight (main beam)

(A) is for road illumination during driving

(B) indicated its movement to the approaching vehicle from back

(C) is an indication of its stationary presence to moving vehicles

(D) indicates the width of vehicle

76. In vapour compression refrigeration cycle, the vapour after leaving the compressor

(A) enters the condenser and gets condensed into low pressure liquid by giving up its sensible heat to the condensing medium

(B) enters the condenser and get condensed into high pressure liquid by giving up its latent heat to the condensing medium

(C) enters the condenser where further expansion of vapour takes place

(D) enters the throttle valve and then temperature of vapour increases

77. The relative humidity for saturated air is

(A) 0 percent

(B) 40 percent

(C) 60 percent

(D) 100 percent

78. In a gas turbine cycle, regenerator is used

(A) heat the gases leaving the combustion chamber

(B) heat the turbine exhaust before it enters the low pressure stage

(C) heat the compressed air on its way to combustion chamber

(D) heat the fuel being supplied to combustion chamber

79. For the same compression ratio, work input per cycle in reciprocating air compressor with 'n' as index of compression

(A) increases with increase in index n

(B) decreases with increase in value of n

(C) first increases and then suddenly decreases with increase in value of n

(D) remains same whatever the value of n

80. Financial management

(A) is limited to procurement of funds

(B) is related to effective procurement of finance but not with its effective utilization

(C) is not the internal part of overall management

(D) involves the application of principles of general management to finance function

81. The first job of finance manager of an enterprise is to estimate

(A) always short term financial requirements of his business

(B) always long term financial requirements of his business

(C) the financial requirements of his business for any period

(D) short term and long term financial requirements of his business

82. Management applies

(A) to any kind of organisation

(B) to managers just to see the problem

(C) to managers for becoming problem watcher

(D) only to production managers of manufacturing unit for decreasing productivity

83. Out of five resources (men, materials, methods, machines and money) of production, the most important resource is

(A) machines with methods

(B) money

(C) men (man power)

(D) materials

84. Inventory

(A) of materials is an idle resource

(B) refers to finished goods lying in stores without any specifications

(C) is not a necessary evil

(D) does not provide money value of usable items

85. Final products ready for dispatch to users or to distributors are classified under

(A) production inventory

(B) finished goods inventory

(C) work in process inventory

(D) operating and maintenance inventory

86. Work study

(A) is an indirect means of improving productivity

(B) is a theoretical concept

(C) does not affect manufacturing cost

(D) embraces the techniques of method study and work measurement

87. Jigs are

(A) used to manufacture duplicate and interchangeable parts with little accuracy

(B) precision tools

(C) very cheap to produce

(D) usually fastened to machine tools

88. Process planning

(A) determines the manufacturing operations required to transform a part from rough to finished status specified on engineering drawing

(B) creates hindrances at each stage of manufacturing

(C) does not determine the time standards for performance of job

(D) never fixes the rates of payment in piece payment system

89. ABC method of inventory control classifies materials based on their

(A) Shape

(B) Size

(C) Value

(D) Storage space

90. Pre-production activities along with pre-determined manufacturing requirements are considered in

(A) production planning only

(B) production control only

(C) coordination control only

(D) planning and control only

91. A material handling equipment

(A) comes under production machinery

(B) decreases the cost of production

(C) increases the cost of production

(D) maximises total handling period

92. The efficiency of hydraulic press is given by

(A) $\frac{W}{P} \times \frac{A}{a}$

(B) $\frac{P}{W} \times \frac{a}{A}$

(C) $\frac{P}{W} \times \frac{A}{a}$

(D) $\frac{W}{P} \times \frac{a}{A}$

Where W = weight lifted by ram

P = force applied on plunger

A = area of ram at its cross-section

a = area of plunger at its cross-section

93. In hydraulic coupling

(A) Series of fixed guide blades are used

(B) Torque is transferred from one shaft to another with the help of an oil

(C) Increased or decreased torque is obtained at the driven shaft

(D) The speed of driven shaft is equal to speed of driver shaft in actual practice

94. A hydraulic accumulator has ram of area $2.5\,m^2$ and a lift of 10 m. Water is supplied at a pressure of 140 kPa. Capacity of accumulator is

(A) 3200 kNm

(B) 3000 kNm

(C) 3500 kNm

(D) 3300 kNm

95. Keys are always made of

(A) Steel

(B) Cast iron

(C) Brass

(D) Bronze

96. A sleeve coupling has been used to connect two shafts of 50 mm diameter. The shear stress induced in the sleeve is much below the allowable shear stress. The outside diameter of the sleeve and length of sleeve will be

(A) 100 mm and 150 mm respectively

(B) 112.5 mm and 175 mm respectively

(C) 110.7 mm and 200.5 mm respectively

(D) 115.2 mm and 249.6 mm respectively

97. The shafts fail due to

(A) Shear load only

(B) Compressive load only

(C) Fatigue and torsional vibrations

(D) Distribution of power

98. A power screw

(A) Converts rectilinear motion into rotary motion

(B) Converts rotary motion into rectilinear motion

(C) Produces non-uniform slow motion

(D) Transmits small force at low speed

99. For corrosive resistance and light weight requirement, rivets are made of

(A) Wrought iron only

(B) Soft steel only

(C) Copper alloy only

(D) Copper alloy and aluminium alloy

100. The portion of tooth between the pitch circle and addendum circle in case of spur gear is

(A) face of the tooth

(B) flank of the tooth

(C) height of the tooth

(D) thickness of the tooth