28/AE/CME/M–2022–8

Booklet Series

A

Serial No. 103769

Candidate's Roll Number

Question Booklet

Paper—VI

MECHANICAL ENGINEERING

(Objective)

Time Allowed : 1 Hour

Maximum Marks : 100

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

IMPORTANT INSTRUCTIONS

1. This Question Booklet contains **50** questions in all.
2. **All** questions carry equal marks.
3. Attempt **all** questions.
4. **Immediately after commencement of the examination, you should check up your Question Booklet and ensure that the Question Booklet Series is printed on the top right-hand corner of the Booklet. The Booklet contains 12 printed pages and no page or question is missing or unprinted or torn or repeated. If you find any defect in this Booklet, get it replaced immediately by a complete Booklet 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. An Answer Sheet will be supplied to you separately by the Invigilator to mark the answers. **You must write your Name, Roll No. and other particulars on the first page of the Answer Sheet provided, failing which your Answer Sheet will not be evaluated.**
7. You will encode your **Roll Number** and the **Question Booklet Series A, B, C or D** as it is printed on the top right-hand corner of this Question Booklet with Black/Blue ballpoint pen in the space provided on **Page–2** of your Answer Sheet. **If you do not encode or fail to encode the correct series of your Question Booklet, your Answer Sheet will not be evaluated correctly.**
8. Questions and their responses are printed in English only in this Booklet. Each question comprises **four** responses—(A), (B), (C) and (D). You are to select ONLY ONE correct response and mark 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. Your total marks will depend on the number of correct responses marked by you in the Answer Sheet.
9. In the Answer Sheet, there are **four** brackets—(A), (B), (C) and (D) against each question. To answer the questions you are to **mark with Black/Blue ballpoint pen** ONLY ONE bracket of your choice for each question. Select one response for each question in the Question Booklet and mark in the Answer Sheet. If you mark more than one answer for one question, the answer will be treated as wrong. **Any erasure or change is not allowed.**
10. 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.
11. 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.

SEAL

1. According to Kennedy's theorem, the instantaneous centres of three bodies having relative motion lie on

(A) a straight line

(B) a circle

(C) a point

(D) a parabola

2. A link AR rotates about a fixed point A on it, P is a point on a slider on the link. At any given instant, ω is angular velocity of the link, α is angular acceleration of the link, v is linear velocity of the slider on the link, f is linear acceleration of the slider on the link, r is radial distance of point P on the slider. The acceleration of P perpendicular to AR is

(A) $f - \omega^2 r$

(B) ωv

(C) $2\omega v + r\alpha$

(D) $2f + \omega^2 r$

3. The locus of trace point, if the follower is moved around the cam, is known as

(A) prime circle

(B) cam circle

(C) base circle

(D) pitch curve

4. The mass of a flywheel fitted to a steam engine is 1000 kg. Its radius of gyration is 500 mm. The starting torque of the engine is 1000 N-m and may be considered constant. The flywheel starts from the rest. The kinetic energy of the flywheel after 10 seconds is

(A) 200 kJ

(B) 180 kJ

(C) 230 kJ

(D) 195 kJ

5. The effort of a governor is the force exerted by the governor on the

(A) sleeve

(B) balls

(C) upper links

(D) lower links

6. The number of teeth in a spur gear is 28. This gear has a module of 2 mm and it rotates at 250 r.p.m. Its circular pitch and pitch line velocity are

(A) $\frac{2}{\pi}$ mm and 38100 $\frac{\text{mm}}{\text{min}}$ respectively

(B) $\frac{\pi}{2}$ mm and 36000 $\frac{\text{mm}}{\text{min}}$ respectively

(C) 6·28 mm and 44000 $\frac{\text{mm}}{\text{min}}$ respectively

(D) 3·14 mm and 42000 $\frac{\text{mm}}{\text{min}}$ respectively

7. In reciprocating engines, the primary unbalanced force

(A) cannot be balanced

(B) can be fully balanced

(C) can be partially balanced

(D) is maximum when the angle of crank with the line of stroke is 45°

8. The critical speed of a rotating shaft

(A) is independent of stiffness of shaft

(B) depends only on mass of rotor

(C) is also called calm and quiet speed

(D) depends on mass, stiffness and eccentricity of the centre of mass for that rotating shaft

9. In a single-degree damped vibrating system, a suspended mass of 5 kg makes 21 oscillations in 11 seconds. The stiffness of the spring will be

(A) $0 \cdot 72 \frac{N}{mm}$

(B) $0 \cdot 85 \frac{N}{mm}$

(C) $0 \cdot 60 \frac{N}{mm}$

(D) $0 \cdot 77 \frac{N}{mm}$

10. A double-riveted lap joint is to be made between 10 mm plates with zig-zag arrangement. The diameter of rivet hole is 20 mm. The safe working stresses in shear and tension are 56 N/mm^2 and 80 N/mm^2 respectively. The rivet pitch will be

(A) 52 mm

(B) 58 mm

(C) 64 mm

(D) 62 mm

11. The head of a cylinder is subjected to a steam pressure of 0·7 N/mm^2. The diameter of the cylinder is 0·2 m. The head is held in position by 10 bolts. The external load on each bolt is

(A) 1600 N

(B) 2000 N

(C) 2200 N

(D) 1800 N

12. Square thread

(A) has the highest efficiency as compared to other power screws

(B) is easier to cut than trapezoidal thread

(C) has the lowest efficiency as compared to other power screws

(D) is more sturdy than trapezoidal thread

13. In an open belt drive, the belt is 10 mm thick and has a mass density of 0·001 g/mm^3. The safe stress in the belt is not to exceed 2·5 N/mm^2. The centrifugal effect on the belts exists while in motion. The tight side tension is 2400 N. The width of the belt is

(A) 80 mm

(B) 120 mm

(C) 95 mm

(D) 100 mm

14. Chains

(A) are used when distance between the shafts is very small

(B) provide constant velocity ratio and high transmission efficiency

(C) occupy more space compared to belt drive

(D) are light in weight as compared to belt

15. With shafts having collinear axes

(A) universal coupling is used

(B) rigid or flexible couplings of various forms are used

(C) clamp coupling cannot be used

(D) flange coupling cannot be used

16. The diameter of journal in a journal bearing fitted in centrifugal pump is 0·1 m and load on it is 15 kN. The length of the bearing is 0·15 m and its speed is 700 revolutions per minute. The value of bearing modulus obtained from this data using absolute viscosity of lubricating oil as 0·02 N-s/m^2 is

(A) 14·0

(B) 13·5

(C) 15·2

(D) 14·8

17. Roller bearings

(A) are widely used in low speed and light duty applications

(B) have higher load capacities than ball bearings for a given overall size

(C) occupy larger space and consist of few number of very large cylindrical rollers

(D) utilize Sommerfeld number for design purpose

18. A body is loaded in such a way that the force passes through the centroids of all resisting cross-sections. Therefore, the body is loaded under

(A) torsion

(B) uniformly distributed load

(C) axial load

(D) bending

19. The coordinates of any point on Mohr's circle represent

(A) state of stress at a point with reference to any arbitrary set of orthogonal axes passing through that point

(B) principal stresses at a point

(C) one of the two direct stresses and shearing stress at a point

(D) two direct stresses at a point

20. Bulk modulus is

(A) not an independent constant of material and it is always positive

(B) an independent constant of material and it can be positive or negative

(C) not a function of Poisson's ratio

(D) zero for incompressible material

21. A simply supported beam of 4 m span carries a uniformly distributed load all over the span of 20 kN. The maximum bending moment is

(A) 20 kN-m

(B) 15 kN-m

(C) 12·5 kN-m

(D) 10 kN-m

22. A neutral plane in a loaded beam is the one

(A) where the fibres are neither in compression nor in tension

(B) which is not free from any stress

(C) which either bends or changes in length

(D) which neither bends nor changes in length

23. A circular cross-sectional solid shaft is rigidly held at one end and torque is applied at the free end. Material of the shaft is isotropically elastic and homogeneous. Its circular section remains circular after loading. Plane cross-section remains plane after loading. Each cross-section rotates as if rigid. Then

(A) shear stress will have the lowest value on the surface

(B) shear stress will have different values on points lying on the circle of given radius

(C) shear stress will be maximum at the centre of the section

(D) shear stress will have the same value at the point lying on the circle of given radius

24. In an internally pressurized thick cylinder

(A) hoop stress varies parabolically but radial stress remains constant

(B) hoop stress remains constant but radial stress varies parabolically

(C) both hoop and radial stresses vary linearly

(D) both hoop and radial stresses vary parabolically

25. A close coiled helical spring is subjected to a torque about its axis. The spring wire experiences

(A) bending stress

(B) direct tensile stress of uniform intensity on its cross-section

(C) direct shear stress

(D) torsional shear stress

26. Babbitt's metal is a

(A) copper-based alloy

(B) tin-based alloy

(C) zinc-based alloy

(D) nickel-based alloy

27. Nichrome is an alloy of

(A) nickel and copper

(B) nickel, iron and manganese

(C) copper and iron

(D) nickel, chromium and iron

28. Duralumin

(A) is an alloy of aluminium which is extensively used in making automobile and aircraft components

(B) is a beryllium-based alloy used for making springs, electrical switches and bushes of bearings

(C) is similar to Monel metal used for making pump impellers

(D) is an alloy of copper, iron and zinc

29. The non-ferrous metal alloy used in thermocouples, Wheatstone bridge circuits, lower temperature heaters and resistance is

(A) Hastelloy

(B) constantan

(C) phosphor bronze

(D) Inconel

30. Mild steel belongs to the category of

(A) high-carbon steel

(B) medium-carbon steel

(C) low-carbon steel

(D) no-carbon steel

31. The most commonly used tool material for all purposes is 18–4–1 high-speed steel. It contains

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

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

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

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

32. In castings, the dendritic structure must be eliminated. The process of

(A) normalizing is essential

(B) full annealing is essential

(C) tempering is essential

(D) austempering is essential

33. According to binary phase diagram of Fe and Fe_3C, the eutectoid reaction occurs on cooling a steel of 0·8% carbon through the eutectoid temperature (725 °C). Then

(A) fast cooling rate gives fine pearlite

(B) by cooling, simply transformation takes place without a compositional change

(C) by cooling, simply austenite of 0·8% carbon decomposes to a mixture of ferrite (α) of 6·67% carbon and cementite of 0·02% carbon

(D) by cooling, simply austenite of 0·8% carbon decomposes to a mixture of ferrite (α) of 0·02% carbon and cementite of 6·67% carbon

34. Thermoplasts

(A) have a three-dimensional network of primary bonds as polymerization proceeds in all directions

(B) are long chain molecules held together by secondary bonds

(C) have decreasing ability to deform plastically with increasing temperature

(D) have secondary bonds and as the thermal energy increases, the secondary bonds never break

35. While machining grey cast iron

(A) discontinuous chips are produced

(B) continuous chips are produced

(C) large coils of chips are obtained and chip disposal is a problem

(D) built-up edge is formed on the cutting edge of the tool

36. In a single-point cutting tool, the side cutting edge angle is

(A) the angle between the end cutting edge and a line normal to the shank

(B) also known as lead angle

(C) the angle between the portion of the side flank immediately below the side cutting edge and a line perpendicular to the base of tool, and measured at right angles to the side flank

(D) also known as complementary angle

37. During metal cutting, the chip thickness ratio

(A) is always more than 1

(B) determines the shear angle from the geometry of chip formation

(C) is the ratio $\left(\frac{\text{length of uncut chip}}{\text{length of chip}}\right)$

(D) is the ratio $\left(\frac{\text{cutting speed}}{\text{chip velocity}}\right)$

38. Grinding

(A) process cannot be used for removing material from materials after hardening

(B) process exerts load on individual cutting grains uniformly

(C) process is intermittent in nature and produces discontinuous chips

(D) wheel has very small number of cutting edges on it

39. Boring

(A) is the process of using a single-point tool to enlarge and locate a previously made hole

(B) is the process of making hole or enlarging a hole in an object by forcing a rotating tool

(C) machine can never be used for drilling, facing, milling, etc.

(D) cannot correct hole location, size or alignment

40. In herringbone gears

(A) the teeth are parallel with the axis of rotation of the gears

(B) lateral thrust is set up by the teeth

(C) lateral or axial thrust is neutralized

(D) motion is transmitted between two non-parallel, non-intersecting shafts which are at right angles

41. Embossing

(A) is a forming operation

(B) is a pressing operation

(C) means shaping a metal blank as it revolves at a high speed in a lathe

(D) is mainly employed to improve the fatigue resistance of metal by setting up compressive stresses on the surface

42. Strain hardening

(A) increases ductility and plasticity of metal

(B) may be defined as increased hardness accompanying plastic deformation of metal

(C) decreases tensile strength of metal

(D) decreases yield strength of metal

43. Work study

(A) is the study of work and totally includes human work

(B) is restricted to shop floor and it may not be applicable anywhere, for example, kitchen, writing desk, gardening, etc.

(C) includes human work as well as dignity of work

(D) fails in the elimination of wasteful efforts

44. Method study is

(A) concerned with the work content of the task itself

(B) helpful in providing yardstick for human effort

(C) systematic and it employs an approach involving select—define—break jobs into elements—measure—establish work unit value

(D) systematic and it employs an approach involving select—record—examine—develop—define—install—maintain

45. Batch production is

(A) suited for medium volume lot of same variety and at regular intervals, the production order is repeated

(B) suited for the manufacturing of continuous identical parts with very high production rate

(C) characterized by the low production volume and product variety is generally very high

(D) used when product variety is very low, which may be one of its kind. Entire plant is designed to cater to a few special varieties of products

46. Cellular layout

(A) is also called functional layout and similar machines or similar operations are located at one place

(B) is based on group technology principle and is suitable for a manufacturing environment in which large varieties of products are needed in small volume

(C) involves various facilities such as machine, equipment, workforce, etc., which are located as per the sequence of operations on parts

(D) is preferred when production is continuous, part variety is less, production volume is high and part demand is relatively stable

47. Automated guided vehicle

(A) is unable to select its own route or path to reach destination

(B) system offers extremely limited flexibility when there is any change in product and in production

(C) system can easily be interfaced with other modules of FMS such as robots, automatic storage and retrieve system, CNC machines, etc.

(D) system is difficult to maintain in any break-down situation

48. Production planning

(A) is a preproduction activity which involves the arrangement of facilities and design of production systems

(B) does not cover strategic planning

(C) does not focus on technical planning

(D) includes dispatching, inspection, expediting and evaluation

49. Linear programming

(A) converts a mathematical model into a physical system

(B) is a technique based on mathematical theory for specifying the ways to use limited resources or constraints of a system to obtain a particular objective when these resources have alternative uses

(C) makes use of non-linear objective function

(D) problems are expressed in the form of non-linear inequalities as constraints

50. There is a single doctor in a primary health centre. Patients arrive at the rate of 32 per hour. The time required to provide service is exponentially distributed with mean of 90 seconds. The mean waiting time of a patient, needing medical check-up facility in the queue, is

(A) 6 minutes

(B) 8 minutes

(C) 8·5 minutes

(D) 5 minutes

SPACE FOR ROUGH WORK

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SEAL

★★★