UNIVERSITY OF MUMBAI

Ph.D ENTERANCE TEST (PET) MAY 2017

MECHANICAL ENGINEERING PROGRAM

Guidelines:

1. Paper consists of 5 (Five) Streams
2. Attempt all questions from any one Stream.
3. Marks assigned are specified on the right side of each section of each Stream.

University of Mumbai

Q. P. Code: 16062

Ph.D. Entrance Examination

Stream: Machine Design

I. Attempt all the questions **(40 Marks)**

1. In case of transient vibrations, amplitude decay follows _____ curve.
   a. linear b. exponential
   c. quadratic d. cubic
2. When frequency ratio is higher than one, the vibration is controlled by adjusting _____.
   a. stiffness b. mass
   c. damping d. None of these
3. Normally for pure radial load _____ bearing is used.
   a. taper roller b. thrust ball
   c. cylindrical roller d. deep groove ball
4. While designing a gear pair, normally material selected for pinion should have _____ strength as compared to that of gear.
   a. equal b. higher
   c. lower d. None of these
5. _____ of both the gears should be same in a gear pair.
   a. Pitch circle diameter b. Number of teeth
   c. Module d. None of these
6. Vibration isolation is effectively implemented when frequency ratio is _____.
   a. less than 1 b. greater than 1
   c. less than $\sqrt{2}$ d. greater than $\sqrt{2}$
7. As damping is introduced in a vibrating system the amplitude peak shifts toward _____.
   a. left of resonance peak b. right of resonance peak
   c. at resonance peak d. None of these
8. For a gear pair, exact centre distance is required to be maintained in case of _____ tooth profile.
   a. involute b. cycloidal
   c. both involute and cycloidal d. None of these
9. Normally hydrodynamic bearings are designed for _____.
   a. minimum friction b. maximum friction
   c. minimum load d. None of these
10. A thin planar body subjected to in-plane loading on its edge surface is said to be in _____.
    a. plane strain b. plane stress
    c. plane strain and plane stress d. None of these
11. For any shape function N_i, N_i = _____ when $x = x_i$.
    a. 1 b. 0
    c. 1.5 d. 0.5

Turn Over

12. For the same load carrying capacity, life of a hydrodynamic bearing is ____ than that of rolling contact bearing.

a. lower
b. higher
c. equal
d. None of these

13. Noise level in case of hydrodynamic bearing is ____ than that of rolling contact bearing.

a. lower
b. higher
c. equal
d. None of these

14. The ratio of the change in dimension at right angles to the applied force to the initial dimension is known as _____.

a. Young's modulus
b. Poisson's ratio
c. Lateral strain
d. Shearing strain

15. If a force of 1 N is acting on a bar having cross sectional area 1 sq.m. along its axis; then the stress induced in the bar is _____, when it's motion is unconstrained.

a. 1
b. infinite
c. 0
d. None of these

16. In the finite element method, _____ boundary conditions are prescribed values of nodal degrees of freedom.

a. Essential
b. Nonessential
c. Natural
d. None of these

17. _____ interpolation can be used between two points at which both ordinate and slope are known.

a. Lagrangian
b. Hermitian
c. Hamilton
d. None of these

18. _____ error does not reject a null hypothesis that is false.

a. Type I
b. Type II
c. Type III
d. Gross

19. _____ statistic is calculated as the ratio of observed sample variances.

a. t
b. Z
c. Chi-square
d. None of these

20. In case of _____ design techniques for reliability, if one part of the system fails, there is an alternate success path, such as a backup system.

a. RCM
b. FMEA
c. redundancy
d. None of these

II. Attempt any three questions **(30 Marks)**

1. Explain with neat sketch the working principle of dynamic vibration absorber.
2. Discuss the factors affecting fatigue and methods to improve fatigue strength.
3. Explain Galerkin's method used in finite element analysis.
4. Explain FMECA used in reliability engineering.
5. Explain orthogonal arrays and ANOVA used in engineering experimentation.
6. Explain plane stress and plane strain conditions used in stress-strain analysis.

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III. Attempt any two questions **(30 Marks)**

1. Explain the basic principle of vibration isolation and different ways of controlling vibration based on isolation principle.
2. Explain various friction and wear theories.
3. Explain in detail selection procedure of rolling contact bearings.
4. Explain in detail the design procedure of a spur gear pair when the input speed, output speed and power to be transmitted are given.

Turn Over

PET – May 2017
(Mechanical Engineering)
SET - II
CAD/CAM

SECTION – I

All questions are compulsory **(40*1= 40 marks)**

1. The shape function of a two bar element is:

A. Linear
B. Quadratic
C. Constant
D. None of the above

2. The CNC drilling machine is considered to be a:

A. Point to point controlled
B. Straight line controlled
C. Continuous path controlled
D. Servo-controlled

3. In following geometrical modeling techniques, which is not a three dimensional modeling?

A. Wireframe modeling
B. Drafting techniques
C. Surface modeling
D. Solid modeling.

4. Cohen Sutherland algorithm is a:

A. Window clipping algorithm
B. Line clipping algorithm
C. surface clipping algorithm
D. Line generation algorithm

5. The order of the cubic spline is the C:

A. 2^{nd} order.
B. 3^{rd} order
C. 1st order
D. 4^{th} order

6. During the execution of a CNC part program block NO20 G02 X45.0 Y25.0 Z5.0 the type of tool motion will be:

A. Circular interpolation-clockwise
B. Circular interpolation-counterclockwise
C. Linear interpolation
D. Rapid feed.

7. The sum of the shape functions over the element is always equal to:

A. Zero
B. Infinity
C. Unity
D. None of the above

8. In a CAD package, mirror image of a 2D point P (5, 10) is to be obtained about a line which passes through the origin and makes an angle of 45^0 counterclockwise with X-axis, the coordinates of the transformed point will be:
A. (7.5,5)
B. (10, 5)
C. (7.5, -5)
D. (10, -5)

9. APT in manufacturing stands for:

A. Automatically Programmed Tool
B. Automatic Programming & Tooling
C. Automated Process Technique
D. None of the above

10. In mechatronic system PID controller is known as:
A. Proportional Integral derivative
B. Programmable integral derivative
C. Proportional interested derivative
D. Programmable Internal derivative

11. Building material in stereolithography is:

A. powder
B. foil
C. solid stock
D. a liquid

12. Machining code for Do loop in CNC part program is
A. G24
B. G25
C. G23
D. G22

13. In computer aided drafting practice the arc is defined as:

A. Two end points only
B. Centre and radius
C. Radius and one end point
D. Two end points and centre.

14. Room temperature vulcanizing is used primarily for:

A. jewelry models
B. tooling for low pressure injection molding
C. medical tool models
D. rubber products

15. The widely employed computer architecture for CAD/CAM application is:

A. Mainframe-based system
B. Minicomputer – based system
C. Microcomputer-based system
D. Workstation based system

16. The following is not a graphics standard

A. GKS
B. IGES
C. UNIX
D. PHIGS

17. Group technology brings together and organizes

A. Parts and simulation analysis
B. Documentation and analysis
C. Automation and tool production
D. Common parts, problems, and tasks

18. In following geometric primitives, which is not a solid entity of CSG modeling?

A. Box
B. Cone
C. Cylinder
D. Circle

19. Which of the following is not a synthetic entity?

A. Hyperbola
B. Bezier curve
C. B-spline curve
D. Cubic spline curve.

20. Convex hull property is satisfied by following surface.

A. Bezier
B. B Spline
C. NURBS
D. All the above

21. Each node of a 1-D beam element has _____degrees of freedom.
A. 1
B. 2
C. 3
D. 4

22. The axis of movement of a robot may include

A. x-y coordinates motion
B. wrist rotation
C. elbow rotation
D. All of these

23. The points in the entire structure are defined using coordinates system is known as....
A. local coordinates
B. natural coordinates
C. global coordinate system
D. none

24. The main function(s) of CAD is (are)

A. Drafting
B. Geometric modeling
C. Documentation
D. All of these

25. The miscellaneous function M08 refers to _____ in CNC lathes.

A. Tool change
B. Coolant on
C. Coolant off
D. Spindle CW

26. CIM technology is an ultimate automated manufacturing methodology, which is fully automated so as to achieve

A. Faster and cheaper product
B. Greater coordination among departments
C. Information flows from bottom to top and top to bottom
D. All of these

27. A plane truss element has a stiffness matrix of order [ ]

A. 2 x 2
B. 4 x 4
C. 6 x 6
D. 1 x 1

28. Which of the following power sources drive(s) the manipulator of a robot?

A. Hydraulic
B. Pneumatic
C. Electric
D. All of these

29. The essential element from which Rapid Prototyping technology is based is:

A. computer aided manufacturing
B. computer aided design
C. laser beams
D. numerical control

30. This type of rapid prototyping system uses a laser to fuse powdered metals, plastics, or ceramics:

A. Fused deposition modeling
B. Stereolithography apparatus
C. Solid ground curing
D. Selective laser sintering

31. In a 2D CAD package, clockwise circular arc radius, 5, specified from P1 (15,10) to P2 (10,15) will have its centre at

A. 10,10
B. 15,10
C. 15,15
D. 10,15

32. For converting CAD and CAM to CIM, one requires a common database and

A. The system must make provision for new techniques
B. There should be a common 3d part description system
C. Technical assistance must be provided to the user
D. The user must have access to both hardware and software

33. Technique, which enables a designer to mould and shape, rather than construct an object using a series of line is

A. Solid modeling
B. Surface modeling
C. Wire frame modeling
D. FEM modeling

34. The solution by FEM is …..

A. always exact
B. mostly approximate
C. sometimes exact
D. never exact

35. Axis parallel to spindle of a CNC machine is

A. Z-axis
B. Y-axis
C. X-axis
D. A-axis

36. The characteristics of the shape functions is:

A. the shape function has unit value at one nodal point and zero value at the other nodes
B. the sum of the shape function is equal to one
C. a & b
D. none

37. The feedback device used for spindle orientation in CNC lathes

A. Proximity switch
B. Incremental encoder
C. Absolute encoder
D. Resolver

38. In a CNC program block, N002 G02 G91 X40 Z40 ...., G02 and G91 refer to

A. Circular interpolation in counterclockwise direction and incremental dimension
B. Circular interpolation in counterclockwise direction and absolute dimension
C. Circular interpolation in clockwise direction and incremental dimension
D. Circular interpolation in clockwise direction and absolute dimension

39. Primary variable in FEM structural analysis is [ ]

A. displacement
B. force
C. Stress
D. strain

40. A flexible manufacturing system may be

A. An automated assembly line
B. Expensive to alter
C. Very difficult to change when new products are introduced
D. All of these

SECTION – II

Attempt any three (03) question out of five (05) **(3*10= 30 marks)**

1. Describe the types of electrical drives used for speed and feed control in CNC machine tools.

2. Explain with an example the application of RP in Automotive industry

3. Why is CAD/CAM used in concurrent engineering environments?

4. Write the steps involved with finite element analysis of a typical problem.

5. What are the basic Geometric commands in a solid Modeling package?

SECTION – III

Attempt any two (02) questions out of four (04) **(2*15= 30 marks)**

1. Explain how CAD helps to synthesize a product design and do engineering analysis for getting optimal design

2. Discuss the importance of geometric transformations in computer graphics with its functions.

3. Describe the role of industrial automation in ensuring overall profitability of a industrial production system. Give examples as appropriate.

4. Briefly explain any two mechatronic system with example.

Ph.D.-PET 2017
Automobile Engg
Set - II

Q. P. Code: 16062

Section – I (Objective Type)

Marks : (40 * 1)

Q.No . 1 A four cylinder engine having capacity of 2.50 litres has a swept volume of

a) 400 cm^3 b) 625 cm^3 a) 700 cm^3 b) 1000 cm^3

Q.No . 2 A car develops a torque of 150 N-m at 3000 rpm in second gear with a gear ratio of 1.75 . Find the etorque (N-m) at wheels if the final gear ratio is 4.25 & the transmission efficiency is 90 % .

a) 1004 b) 1025 c) 1040 d) 1200

Q.No . 3 The spark plug electrode gap is around

a) 0.25 mm b) 1.00 mm c) 0.75 mm d) 2.00 mm

Q.No . 4 For the same maximum combustion pressure & temperature

a) Diesel cycle is efficient than otto cycle | b) Otto cycle is efficient than diesel cycle | c) Both are equally efficient | d) None of the above

Q.No . 5 The formula for isooctane is

a) C_7H_{17} b) C_8H_{18} c) C_6H_{18} d) C_7H_{18}

Q.No . 6 A clutch is generally designed to transmit --- % of engine torque .

a) Same b) 150 c) 90 d) 200

Q.No . 7 It is necessary to maintain valve clearances

a) To reduce friction | b) To allow lengthening of valves due to heat | c) To increase speed | d) For proper alignment

Q.No . 8 The vehicle ride will be comfortable if

a) The unsprung mass is kept minimum | b) The Sprung mass is kept minimum | c) Vehicle mass is kept minimum | d) All of them

Q.No . 9 The coefficient of rolling resistance for avehicle weighing 63500 N is 0.018 . The rolling resistance of the vehicle is

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

Q.No . 10 The CNG gas is stored at ----- bars of pressure in cylinder

a) 200 b) 250 c) 300 d) 100

Q.No . 11 The valve overlap in 4-stroke petrol engine valves is generally

a) 30^0 b) 45^0 c) 60^0 d) 90^0

Q.No . 12 In diesel engines the pressure at the end of the compression sroke is ----- bars

a) 15 b) 25 c) 35 d) 45

Q.No . 13 The maximum torque multiplication available in torque converter is ----

a) 2.5 b) 10 c) 15 d) 25

Q.No . 14 The gradient resistance experienced by a vehicle of mass 980 Kg moving on an incline of 10^0 is ---- N

Turn Over

a) 1.67 b)16.69 c) 166.94 d) 1693.4

Q.No . 15 The air resistance to a car at 20 kmph is R . What is the air resistance of the same vehicle at speed of 40 kmph.

a) R b) 2R c) $4R^2$ d) 4R

Q.No . 16 The camshaft of a 4-stroke diesel engine running at 1000 rpm will run at ---- rpm

a) 500 b) 1000 c) 1500 d) 2000

Q.No . 17 If the tyre is designated as 175/65 R14S , then the aspect ratio of the tyre is

a) 175 b) 65 c) 14 d) 82

Q.No . 18 The wheel base of an automobile is the distance between

a) Front wheels b) Rear wheels c) Front wheel axis & rear wheel axis d) CG & Rear wheels

Q.No . 19 In final drive of an automobile following gears are used

a) Spur b) Bevel c) Hypoid d) Spiral

Q.No . 20 Torsion bar is a component of

a) Braking System b) Transmission System c) Suspension System d) Starting System

Q.No . 21 As per Euro – IV norms the carbon monoxide permissible is -----mg

a) 1 b) 2 c) 1.5 d) 2.5

Q.No . 22 The stoichiometric airfuel ratio for the petrol engine is

a) 16: 1 b) 17:1 c) 18: 1 d) 14.5 : 1

Q.No . 23 The compression ratio of diesel engines is in the range

a) 12:1 to 22:1 b) 8:1 to 12:1 c) 15:1 to 20:1 d) 10:1 to 20:1

Q.No . 24 The following I.C. engine does not have reciprocating piston

a) Steam Engine b) Diesel Engine c) Radial Engine d) Wankel Engine

Q.No . 25 The following device enables different speeds of inner and outer wheels of an automobile to avoid skidding while taking a turn

a) Differential b) Gearbox c) Clutch d) Brakes

Q.No . 26 The following device is used to stepup the speed beyond top gear speed

a) Transfer case b) Overdrive c) Accelerator d) Differential

Q.No . 27 For climbing higher gradients the vehicle needs higher

a) Speed b) Torque c) Fuel Consumption d) Octane Fuel

Q.No . 28 Automatic transmissions use the following type of clutch

a) Fluid flywheel b) Torque converter c) Cone clutch d) Plate clutch

Q.No . 29 For cranking of engine following device is used

a) Alternator b) Starter c) Battery d) Generator

Q.No . 30 The angle made by the wheel plane with the vertical is known as

a) Camber b) Castor c) KPI d) Toe-in

Q.No . 31 The angle made by the kingpin axis in the in the plane of the wheel with vertical axis is known as

a) Castor b) Camber c) KPI d) Toe-Out

Q.No . 32 The following steering mechanism gives perfect rolling condition in all its positions

a) Ackerman b) Davis c) Rack & Pinion d) Recirculating ball

Q.No . 33 For converting CO , HC & NOx from engine exhaust following device is used

a) Two way catalytic converter b) Three way catalytic converter c) Exhaust gas recirculation d) Crank case ventilation.

Q.No . 34 Strong & light weight wheels are made from

a) Al alloys b) Mg alloys c) Carbon fibres d) FRP

Q.No . 35 The coefficient of drag is indicative of

a) Wind resistance b) Fuel efficiency c) Thermal efficiency d) Rolling resistance

Q.No . 36 Which of the following option is not seen as paradox in automobiles

a) Torque & speed b) HC / CO & NOx c) Ride & Handling d) Weight & momentum

Q.No . 37 For connecting rods the following section is preferred

a) Rectangular b) I-Section c) Tubular d) Oval

Q.No . 38 Torsional rigidity can be obtained in vehicular structures by having

a) Integral Structures b) Tubular Chasis c) Bulkheads d) Flat Structures

Q.No . 39 The following sensor senses cylinder pressure rise

a) MAP b) Hall effect c) Knock d) Lambda

Q.No . 40 Bulkheads are used to take

a) Vertical & Horizontal Loads b) Torsion c) Bending d) Shear

Section – II (Subjective Type)

Marks : (3 * 10)

- Answer any three questions

1. Discuss integral , semi-integral & flat structures & their aplications.
2. Write a note on automotive emissions & control.
3. Explain design considerations of an I.C.Engine piston.
4. Explain the necessity of gear box & performance curves.
5. What are the sources of vibrations in an automobile & how these can be reduced.

Section – III (Subjective Type)

Marks : (2 * 15)

- Answer any two questions

1. Discuss how automotive technology has evolved in terms of fuel efficiency , safety & emissions ?
2. Discuss active & passive safety in automobiles.
3. Explain a) ABS b) Drive by wire c) Fuel Cell vehicle
4. a) Define the terms tractive effort , total resistance , gradability & drawbar pull .
   b) Two cars , similar in all respects excepting that one has RWD & other FWD are used on a test track . The weight of the cars is 14239 N each , with 50 % on each axle , the wheel base is 2.666m & the CG above ground is 0.534 m . If the coefficient of friction of the track is 0.6 , which car will ascend higher grade ? (% Grade = tan Θ)

THERMAL ENGINEERING STREAM

Note:
1. The questions of this stream consist of three (03) sections.
2. Section –I, II and II carry 40, 30 and 30 marks respectively.

Total marks: 100
Time: 3 hours

SECTION- I (1×40 =40 marks)

- All questions are compulsory.
- Write your most appropriate choice.
- Answers with over writing will not be considered.

1. The moisture in the refrigerant system is removed by
   A. Driers B. filters C. desiscant D. all of the above

2. Otto cycle efficiency is higher than Diesel cycle efficiency for the same compression ratio and heat input because in Otto cycle
   A. expansion and compression are isentropic
   B. maximum temperature is higher
   C. combustion is at constant volume
   D. heat rejection is lower

3. On burning a fuel, if water is released in the vapor phase, the heating value of fuel is called
   A. enthalpy of formation B. lower heating value
   C. higher heating value D. none of the above.

4. As the relative humidity decreases for constant DBT, the DPT.
   A. Increases C. Decreases
   B. remains same D. no relation with R.H.

5. Thermal diffusivity (α) is given by
   A. $\frac{k}{\rho}$ B. $\frac{k}{c}$ C. $\frac{k}{\rho c}$ D. $\frac{\rho c}{k}$

6. The reheat cycle is used to
   A. Prevent excess moisture content in low stage turbine
   B. Utilizes heat of the gases
   C. Improve condenser performance
   D. Increase plant efficiency

7. Of all the power plants, hydel is more disadvantageous when one compares the
   A. nearness to load centre
   B. cost of energy resource
   C. technical skill. required
   D. economics that determine the choice of plant

8. The pressure and temperature at the end of compression stroke in a petrol engine are of the

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order of

A. 4-6 bar and 200°- 250°C
B. 6-12 bar and 250°- 300°C
C. 12-20 bar and 350°- 450°C
D. 20-30 bar and 450°- 500°C

9. Isothermal compression is most desirable but is not practicable
   A. it is impossible in practice.
   B. it requires big cylinder.
   C. compressor has to run at a very slow speed.
   D.it is generally not done.

10. The evaporator of an air conditioner is a heat exchanger of
   A. shell and tube type
   B. plate type
   C. tube and fin type
   D. regenerator type

11. The latent heat of vaporization above critical point is
   A. less than zero
   B. greater than zero
   C. equal to zero
   D. not defined.

12. The thermodynamic efficiency of a rotary compressor is based on
   A. isothermal compression B. isentropic compression
   C. adiabatic compression D. polytrophic compression

13. The working cycle of gas turbine is
   A. Otto B. Brayton C. Carnot D. Atkinson E. Rankine

14. The leakage in refrigeration system is detected by
   A. The odour
   B. Sulphur stick
   C. Halide torch
   D. All of the above
   E. None of the above

15. Choose the correct statement
   A. The refrigerant absorbs heat in the condenser
   B. The refrigerant boils in the condenser
   C. The refrigerant always sub-cooled as it leaves in the condenser
   D. The refrigerant is a liquid as It leaves the condenser

16. In Mollier chart, the wet vapour region is represented by the space
   A. to the left of saturated liquid line
   B. to the right of saturated liquid line
   C. between the saturated liquid line and saturated vapour line
   D. none of the above

17. Which of the following refrigerant liquids has the highest critical temperature

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A. F-11 B. F-12 C. F-22 D. NH_3

18. A moderator generally used in nuclear power plants is
    A. heavy water
    B. graphite
    C. concrete
    D. graphite and concrete

19. The fine is beneficial for heat transfer if
    A. $\frac{hA_c}{P} \leq 1$ B. $\frac{hA_c}{Pk} \leq 1$ C. $\frac{Pk}{hA_c} < 1$ D. $\frac{Pk}{h} > 1$

20. Which of the following is an iterative technique to solve system of linear algebraic equation
    A. Gauss elimination. B. Gauss Seidel method,
    C. Matrix inversion D. LU decomposition

21. A CANDU reactor uses
    A. Highly enriched uranium as fuel and light water as moderator and coolant.
    B. Natural uranium as fuel and heavy water as moderator and coolant.
    C. Enriched uranium as fuel and ordinary water as moderator and coolant.
    D. Only fertile material

22. Outflow boundary condition can be represented mathematically as
    A. V = constant
    B. $\frac{dV}{dn} = 0$
    C. $\frac{dV}{dn} = \text{constant}$
    D. None of these

23. Feed water is used as both coolant and moderator in
    A. BWR
    B. PWR
    C. CANDU type
    D. Both (A) & (B)

24. The effective inhibitor of pre-ignition is
    A. water
    B. lead
    C. Hg
    D.none of these

25. The degree of closeness of the measured value of a certain quantity with its true value is known as
    A. Accuracy
    B. Precision
    C. Standard
    D. Sensitivity

26. The materials used in the manufacture of thermistors are
    A. Oxides of manganese and cobalt
    B. Oxides of iron and zinc
    C. Carbides of silicon and germanium
    D. All of these

27. Which among the following statements is correct about LVDT?
    A. It converts pressure into electrical output
    B. It converts strain into electrical output
    C. It converts linear displacement into electrical signal
    D. All of these

28. The major constituent of natural gas is
    A. Methane
    B. Ethane
    C. Propane
    D. Butane

29. In order to have good engine performance
    A. The fuel should have low boiling temperature for lower warm up period
    B. The percentage of volume evaporated at low temperatures should be small
    C. A rich mixture of air-fuel ratio of 12 to 13:1 is considered to be suitable for easy starting of the engine
    D. All of the above

30. Incomplete combustion gives
    A. CO_2
    B. CO
    C. Carbon
    D. None of these

31. The solid fuels can be used in Internal combustion engine only after their
    A. Solidification
    B. Liquefaction
    C. Gasification
    D. All of the above

32. Energy audit is carried out to
    A. Check energy theft
    B. Verify adherence of rules and regulations in financial matters
    C. Calculate total energy consumed by a user
    D. Check any laps in respect of efficient use of energy and to suggest measures for its correction

33. In petrol engine, increase of cooling water temperature will
    A. Increase knocking tendency
    B. Decrease knocking tendency
    C. Not affect knocking tendency
    D. Unpredictable.

34. The efficiency of a commercial solar cell lies in the range of
A. 0-10%, B. 10-20%, C. 20-30%, D. 30-40%

35. The work done in free expansion process is
A. +ve
B. –ve
C. Zero
D. Maximum
E. Minimum

36. A dense white smoke from a chimney indicates
A. Insufficient air
B. Too much air
C. Correct air
D. Less turbulence mixing

37. For the production of very low temperature, the COP of vapor compression system
A. increase,
B. decrease,
C. remain same,
D. first increases the decreases

38. Biogas is predominantly
A. H_2 B. CO C. CO_2 D. CH_4

39. Energy flux in waves is
A. Less than that in wind energy
B. More than that in wind energy
C. Comparable to wind energy
D. More than that in wind energy but less than in solar energy

40. The most preferred propellant in modern rocket propulsion system is
A. Liquid H_2 B. Liquid N_2 C. Liquid O_2 D. Liquid He

SECTION- II (10×3 = 30 marks)

Attempt any **THREE (03)** questions out of five (05).

1. Write down the finite difference analogous of the equation and solve it for the region bounded by the square $0 \le x \le 4$ and $0 \le y \le 4$,

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$$

The boundary conditions being

$u = 0$ at $x = 0$, and $u = 8 + 2y$ at $x = 4$

$u = \frac{1}{2}x^2$ at $y = 0$ and $u = x^2$ *when* $y = 4$

Formulate it to compute the values of u at an internal points (mid point) using Gauss-Seidel Method.

2. What do you understand by static and dynamic pressure? Give suitable examples and discuss the types of manometers with their application.

3. What specific feature solar energy has as a source of non-conventional energy? Compare it with other resources as a potential source of power generation in India. Explain different approach of using it for power generation.

4. What is transient conduction? Discuss different approach to model it? Explain limitation of each method.

4. Explain the mechanism of boundary layer separation. How does it affect drag. What are the different method to control it?

SECTION- III **(15×2 = 30 marks)**

Attempt any **TWO (02)** questions out of four (04).

1 Discuss the characteristics of turbulent flow heat transfer. How turbulence analogy been established between heat transfer and momentum transfer by Reynolds, Colburn, Von Karman? Write the correlations.

2 What are different methods of producing very low temperature? List all feasible methods and explain magnetic refrigeration with appropriate schematic diagram.

3 What is water pollution? How does it impact our environment? Identify different causes of water pollution in India and discuss their impact on water quality.

4. Differentiate between LPG and PNG, based on their source, composition, heating value and application.
Write stoichiometric combustion equation of 'ETHENE' in presence of air. Explain following terms with reference to that combustion equation:
   (a) Complete and Incomplete combustion
   (b) Lean and rich mixture
   (c) High calorific value and low calorific value
   (d) Heat of formation
   (e) Adiabatic flame temperature

Instructions: All questions are compulsory

You are required to write question numbers clearly and legibly

SECTION – I

(Manufaturing) **(40*1= 40 marks)**

1. Ability of a material to resist deformation due to stress is called
   (A) Toughness
   (B) Stiffness
   (C) Plasticity
   (D) Hardness

2. When Silicon added to Copper, it increases
   (A) Machinability
   (B) Brittleness
   (C) Electrical conductivity
   (D) Hardness and strength

3. In resistance welding, pressure is released
   (A) During heating period.
   (B) After the weld cools.
   (C) No pressure is applied.
   (D) None of the above.

4. The forging temperature in the forge welding process is about
   (A) 350^0C
   (B) 500^0C
   (C) 1350^0C
   (D) 1000^0C

5. Silicon steel is widely used in
   (A) Cutting tools
   (B) Connecting rods
   (C) Electrical industry
   (D) Chemical industry

6. Gating ratio 3:2:2 indicates
   (A) Pressurized gating system
   (B) Unpressurised gating system
   (C) Bottom gating system
   (D) None of the above

7. The finishing teeth of a broaching tool are provided with
   (A) Larger amount of land.
   (B) Small amount of land.
   (C) Average amount of land.
   (D) None of these.

8. 18-4-1 high steel contains
   (A) 18% V, 4% Cr, 1% W
   (B) 4%V, 18% Cr, 1% W
   (C) 1% V, 4% Cr, 18% W
   (D) 18% V, 1% Cr, 4% W
   V-Vanadium, Cr-Chromium, W-Tungsten

9. Monel is an alloy of
   (A) Cu and Cr
   (B) Ni and Cu
   (C) Ni and Cr
   (D) Cu, Ni and Cr

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

11. Steel with carbon above 0.8% is called
   (A) Eutectoid steel
   (B) Hyper eutectoid steel
   (C) Hypo eutectoid steel
   (D) Ferrite

12. Circular blanks of 10mm diameter are punched from an aluminium sheet of 2mm thickness. The shear strength of aluminium is 80MPa. The minimum punching force required in kN is
   (A) 2.57
   (B) 5.03
   (C) 3.29
   (D) 6.33

13. Therbligs refer to the
   (A) Basic types of fixtures used in machining
   (B) Basic types of waste in manufacturing process
   (C) Fundamental motions used in manual work
   (D) Fundamental types of material handling systems

14. Customers arrive at a ticket counter at a rate of 48 per hr and tickets are issued in the order of their arrival. The average time taken for issuing a ticket is 1 *min*. Assuming that customer arrivals form a Poisson process and times are exponentially distributed, the average time in queue in *min* is
    (A) 3
    (B) 4
    (C) 5
    (D) 6

15. The ratio of maximum shear stress developed in beam of rectangular section to that of the average shear stress is
    (A) 2
    (B) 1.5
    (C) 3
    (D) 1

16. Which of the following is trapezoidal thread?
    (A) Acme
    (B) Square
    (C) Buttress
    (D) All of these

17. In drawing operation, with the increase of die radius
    (A) punch load increases.
    (B) has no impact on punch load.
    (C) has much influence and it decreases.
    (D) none of these.

18. Which of the following force does not act in case of fluids?
    (A) Centrifugal force
    (B) Tensile force
    (C) Vibratory force
    (D) Elastic force

19. A metric thread of pitch 2mm and thread angle 60^0 is inspected for its pitch diameter using 3-wire method. The diameter of the best size wire in mm is
    (A) 1.00
    (B) 0.866
    (C) 1.154
    (D) 2.00

20. The average function defective of process under statistical control is 0.9 and the sample size is 100. What is lower control limit in the p-chart?
    (A) 0.1
    (B) 0.01
    (C) 0.001
    (D) None of these.

21. Freezing temperature of petrol is nearly
    (A) 1^0C
    (B) 10^0C
    (C) -10^0C
    (D) Below -30^0C

22. If tool life relationship for HSS tool is $VT^{1/8}= C_1$, and for tungsten carbide is $VT^{0.2}=C_2$, and tool life for both at cutting speed of 25m/min. is equal and is 3 hours in each case. What is the ratio of their lives at a speed of 32m/min.?
    (A) 1.08
    (B) 1.58
    (C) 2.08
    (D) 2.58

23. The least count of a metric vernier caliper having 25 division on vernier scale, matching with 24 divisions of main scale (1main scale=0.5mm) is
    (A) 0.05mm
    (B) 0.01mm
    (C) 0.02mm
    (D) 0.001mm

24. Which of the following metal is most suitable for electro forming?
    (A) Lead
    (B) Zinc
    (C) Silver
    (D) Gold

25. Tumbling is the process of
    (A) Improving the fatigue limit
    (B) Imparting luster to surface
    (C) Cleaning the surface of small parts
    (D) Improving creep limit

26. Which of the following is the natural abrasive?
    (A) Al_2O_3
    (B) SiC
    (C) Boron-carbide
    (D) Corundum

27. Drilling brass and bronze, the lubricant used is
    (A) Keroscene
    (B) A flood of soluble oil
    (C) Dry
    (D) Soda water

28. Dual of the dual is the
    (A) Dual
    (B) Primal.
    (C) Either dual or primal.
    (D) None of these.

29. Volume of work produced in a FMS environment is determined from
    (A) in numbers of machine used in the FMS.
    (B) kind of material handling equipment used in FMS.
    (C) kind of layout used in FMS.
    (D) all of these.

30. Forge welding is best suited for
    (A) Stainless steel
    (B) High carbon steel
    (C) Cast iron
    (D) Wrought iron

31. Which of the following method is not used for testing straightness?
    (A) Spirit level method
    (B) Autocollimator
    (C) Interference method
    (D) Beam comparator

32. Ultrasonic welding is a
    (A) High temperature joining process
    (B) Pressureless arc welding process
    (C) Cold joining process
    (D) None of these

33. Which of the following abrasive will be used for grinding ceramics?
    (A) Diamond
    (B) Al_2O_3
    (C) SiC
    (D) Boron carbide

34. Automobile assembly line is the typical example of
    (A) Synthetic process
    (B) Analytical process
    (C) Conditioning process
    (D) Extractive process

35. Materials which are usually most ductile has
    (A) Face centered cubic lattice
    (B) Body centered cubic lattice
    (C) Hexagonal close-packed lattice
    (D) All of these

36. Drilling of hole (0.025) in fuel injection nozzle can be done by
    (A) ECF
    (B) ECG
    (C) EDM
    (D) ECM

37. In ABC analysis, C items are those which represent
    (A) Small percentage of the total annual consumption value
    (B) High percentage of the total annual consumption value
    (C) Small percentage of closing inventory value
    (D) High percentage of closing inventory value

38. Match the following:

Group I

P. Form design
Q. Concurrent Engineering
R. Value Engineering
S. Product life cycle

Group II

1. Introduction, growth, maturity and decline.
2. Determines cost of each function of the design.
3. Integration of product design and manufacturing.
4. Appearance, shape, colour and size of product.

(A) P-4, Q-1, R-2, S-3
(B) P-3, Q-2, R-4, S-1
(C) P-4, Q-3, R-2, S-1
(D) P-4, Q-2, R-3, S-1

39. CPM is

(A) Time oriented technique.
(B) Event oriented technique.
(C) Activity oriented technique.
(D) Target oriented technique

40. Oxygen to acetylene ratio in case of carburizing flame is

(A) 0.9:1
(B) 0.6:1
(C) 0.7:1.
(D) 0.8:1

SECTION – II

Attempt any three (03) questions out of five (05) **(3*10= 30 marks)**

Q1. A) Explain hardening and tempering processes used in heat treatment.

B) Discuss in detail the working principle of Porter Governor.

Q2. A) Explain direct numerical control (DNC) system followed in manufacturing.

B) Describe in detail 3 wire methods for measuring effective diameter.

Q3.A) Discuss in detail various materials used to manufacture cutting tools.

B) Explain in detail the impact extrusion process with an example.

Q4. A) Discuss various allowances provided in designing multi impression forging dies.

B) Explain in detail the hot chamber die casting process.

Q5. A) Elaborate in detail the electron beam machining process.

B) Discuss in detail the working principle of Auto collimator.

SECTION – III

Attempt any two (02) questions out of four (04) **(2*15= 30 marks)**

Q6. Explain the process and importance of literature review and problem definition in research studies. Also explain different methods used for data collection and its relevance as well as various sources of data as applicable in research.

Q7. Discuss in detail the Management information system by clearly narrating with suitable case examples.

Q8. Describe the Shainin design of experiment as a tool used in research in detail.

Q9. Explain and elaborate on the intellectual property system in detail. Use narrative cases to discuss relevant points.
