

(3 Hours)

[Total Marks : 100
28th April, 2012

- N.B. : • The question paper consists of three (03) sections.
• Section -I, II and III carry 40, 30 and 30 marks respectively.

Stream: Machine Design

I. Attempt all the questions

(40 Marks)

- In case of transient vibrations, amplitude decay follows _____ curve.
a. linear
b. exponential
c. quadratic
d. cubic
- When frequency ratio is higher than one, the vibration is controlled by adjusting _____.
a. stiffness
b. mass
c. damping
d. None of these
- Normally for pure radial load _____ bearing is used.
a. taper roller
b. thrust ball
c. cylindrical roller
d. deep groove ball
- 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
- _____ 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
- 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 $\sqrt{2}$
- 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
- 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
- Normally hydrodynamic bearings are designed for _____.
a. minimum friction
b. maximum friction
c. minimum load
d. None of these

[TURN OVER

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.

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.
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STREME: Thermal Engineering

20×2 = 40 marks

- 1 A finned tube hot water radiator with a fan blowing air over it is kept in rooms during winter. The major portion of the heat transfer from the radiator to air is due to
- a) radiation b) convection
c) conduction d) combined conduction and radiation.
- 2 When a hot metal piece is left to cool in air the time rate of cooling of the outer layer will be
- a) slower at start and faster near the end, b) faster at start and slower near the end
c) both rates will be the same, d) this will depend on the material.
- 3 The most effective way to reduce the temperature drop in a heat generating solid is to
- a) reduce the linear dimension, b) reduce the thermal conductivity
c) reduce the convection coefficient on the surface d) reduce the heat generation rate.
- 4 Nusselt number is
- a) ratio of viscous to inertia forces b) dimensionless heat transfer coefficient
c) ratio of conduction to convection resistance
d) signifies the velocity gradient at the surface.
- 5 In flow through pipes for the same Reynolds number,
- a) The thermal entry length is longer for low Prandtl number fluids
b) The thermal entry length is longer for high Prandtl number fluids
c) Prandtl number does not influence the thermal entry length.
d) The thermal entry length effect is more pronounced only in turbulent flow.
- 6 The heat transfer rate in free convection in the laminar region depends on
- a) ΔT b) $\Delta T^{1.25}$
c) $\Delta T^{1.33}$ d) $\Delta T^{0.25}$.
- 7 Choose the correct statement-
In the lumped parameter model, the temperature variation is
- a) linear with time b) sinusoidal with time
c) exponential with time d) cubic with time.

8 The Central difference representation of the first order derivative in finite difference scheme of domain discretization is

a) $\left(\frac{dT}{dx}\right)_i = \frac{T_{i+1} - T_i}{\Delta x}$

b) $\left(\frac{dT}{dx}\right)_i = \frac{T_{i+1} - T_{i-1}}{2\Delta x}$

c) $\left(\frac{dT}{dx}\right)_i = \frac{T_i - T_{i-1}}{2\Delta x}$

d) $\left(\frac{dT}{dx}\right)_i = \frac{T_{i+1} - 2T_i + T_{i-1}}{(\Delta x)^2}$

9 Upwind scheme is used for numerical treatment of

- a) Transient term
- b) Diffusive term
- c) Convective term
- d) None of the above

10 Thermal convective boundary condition can be represented as

a) $-k \frac{\partial T}{\partial x} = 0$

b) $-k \frac{\partial T}{\partial x} = q$

c) $\sigma(T^4 - T_f^4) = -k \frac{\partial T}{\partial x}$

d) $h(T - T_f) = -k \frac{\partial T}{\partial x}$

11. SIMPLE algorithm is used to solve

- a) Grid problem
- b) Pressure and velocity decoupling
- c) High speed flows
- d) Moving boundary problem

12 Anemometer is used to measure

- a) Velocity b) Pressure
- c) Viscosity d) Density

13 The efficiency of a nuclear power plant in comparison to a conventional thermal power plant is

- a) Same b) More c) Less d) May be less or more depending on size

14 Which of the following is an equipment for control of air pollution due to gaseous contaminants

- a) Cyclone
- b) ESP
- c) Settling chambers
- d) Incinerator

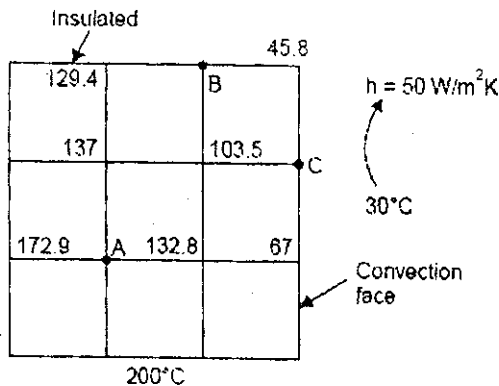
- 15 According to Bharat norms, the following emission is not allowed in Indian gasoline vehicles
- a) Tail pipe emission
 - b) Crankcase emission
 - c) Evaporative emission
 - d) All the above
- 16 Thermal power plants are mainly responsible for emission of following in the environment
- a) NO_x
 - b) SO_x
 - c) CO
 - d) Aerosol
- 17 The purpose of cladding the Uranium fuel rods in a nuclear reactor is to
- a) Enhance rate of heat transfer from fuel rod
 - b) Provide cooling and control temperature of fuel rod
 - c) Prevent oxidation of fuel rod
 - d) Provide strength to fuel rod
- 18 As the ratio of Hydrogen to Carbon atoms in a fuel increases, the heating value of the fuel
- a) Increases
 - b) Decreases
 - c) Increases to certain ratio and then decreases
 - d) Decreases to certain ratio and then increases
- 19 In Thermo-chemistry, Enthalpy of formation of the following is taken as reference (equal to 0)
- a) α - graphite
 - b) β - graphite
 - c) Diamond
 - d) Amorphous Carbon
- 20 For a high speed diesel engine operating above 1500 rpm, the Cetane Number of the fuel should be
- a) 25-30
 - b) 30-35
 - c) 35-40
 - d) 45-50

Section III

Attempt any TWO (02) questions out of four.

15×2 = 30 marks

- 1 It is proposed to heat the window glass panes in a living space at 26°C. A company offers resistance embedded glasses with uniform heat generation. The outside is at - 15°C, and the convection coefficient on the outside is 20 W/m²K. The pane is 8 mm thick and has a conductivity of 1.4 W/mK. What should be heat generation rate if the inside surface temperature is equal to the room temperature.
- 2 The temperature distribution and boundary condition in part of a solid is shown in following figure. Determine the Temperatures at nodes marked A, B and C. Determine the heat convected over surface exposed to convection. k = 1.5 W/mK.



- 3 Explain the concept of 'Sustainable Development' with an illustration.
- 4 Explain any one method of controlling air pollution due to vehicular exhaust.



STREAM: AUTOMOBILE ENGINEERING

Objective Type Questions – 40 Marks

1. The following relationship indicates that the process is Polytropic
(i) $P.V^n = \text{Constant}$ (ii) $P.V = \text{Constant}$ (iii) $P.V^\gamma = \text{Constant}$ (iv) $P.V = mRT$
2. The following relationship indicates that the process is Adiabatic
(i) $P.V^n = \text{Constant}$ (ii) $P.V = \text{Constant}$ (iii) $P.V^\gamma = \text{Constant}$ (iv) $P.V = mRT$
3. The stoichiometric airfuel ratio for the petrol engine is
(i) 18 (ii) 20 (iii) 24 (iv) 14.5
4. The compression ratio of diesel engines is in the range
(i) 12:1 to 22:1 (ii) 8:1 to 12:1 (iii) 15:1 to 20:1 (iv) 10:1 to 20:1
5. The following I.C. engine does not have reciprocating piston
(i) Steam engine (ii) Diesel engine (iii) Radial engine (iv) Wankel engine
6. The following device enables different speeds of inner and outer wheels of an automobile to avoid skidding while taking a turn
(i) Differential (ii) Gearbox (iii) Clutch (iv) Brakes
7. The following device is used to stepup the speed beyond top gear speed
(i) Transfer case (ii) Overdrive (iii) Accelerator (iv) Differential
8. For heavy duty vehicles following type of clutch is used
(i) Diaphragm clutch (ii) Single plate clutch (iii) Multiplate clutch (iv) Centrifugal clutch
9. For climbing higher gradients the vehicle needs higher
(i) Speed (ii) Torque (iii) Fuel consumption (iv) octane fuel
10. Automatic transmissions use the following type of clutch
(i) Fluid flywheel (ii) Torque converter (iii) Cone clutch (iv) Plate clutch
11. For cranking of engine following device is used
(i) Alternator (ii) Battery (iii) Starter motor (iv) Generator
12. The angle made by the wheel plane with the vertical is known as
(i) Camber (ii) Castor (iii) KPI (iv) Toe-in
13. The angle made by the kingpin axis in the plane of the wheel with vertical axis is known as
(i) Camber (ii) Castor (iii) KPI (iv) Toe-out
14. The following steering mechanism gives perfect rolling condition in all its positions
(i) Ackerman steering (ii) Davis steering (iii) Rack & pinion (iv) Recirculating balls
15. For converting CO, HC & NOx from engine exhaust following device is used
(i) Two way catalytic converter (ii) Three way catalytic converter (iii) Exhaust gas recirculation (iv) Crank case ventilation.
16. Strong & light weight wheels are made from
(i) Al alloys (ii) Mg alloys (iii) Carbon fibres (iv) FRP
17. The coefficient of drag is indicative of
(i) Wind resistance (ii) Fuel efficiency (iii) Thermal efficiency (iv) Rolling resistance
18. To avoid rolling of vehicles the position of the following is designed
(i) Roll axis (ii) Roll centre (iii) CG (iv) KPI
19. Torsional rigidity can be obtained in vehicular structures by having
(i) Integral structures (ii) Tubular structures (iii) Roll over cage (iv) Bulkheads
20. Which of the following option is not seen as trade off in automobiles
(i) Torque & speed (ii) HC / CO & NOx (iii) Ride & Handling (iv) Weight & momentum

Small questions 30 marks (Any 3; 10 Marks each)

1. Sketch the block diagram showing all units of 4 wheel drive
2. Explain the working of a differential
3. Explain the working of disc brakes
4. Explain advantages of independent suspension system
5. Explain the term steering geometry
6. Explain design considerations of a friction clutch

Long questions 30 marks (Any 2; 15 Marks each)

1. Explain how computer controlled engines work. Also describe other systems where computer control is used
 2. Explain the latest trends in automobile design in terms of fuel efficiency, emission norms, safety , aerodynamics & drivability
 3. List and explain various CAE tools used for design and analysis of various automobile components and systems
 4. Give an account of various automotive sensors
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STREME: CAD/CAM

SECTION-I

1. The binary number for 13 is
 - A. (1110)
 - B. (1010)
 - C. (1101)
 - D. (0110)
2. Programmable controllers
 - A. Are programmed using relay ladder logic and are widely used in many different machine
 - B. Are poor industrial controller with limited use
 - C. Cannot perform functions other than relay logic
 - D. All of these
3. The speeds at which the monitor accepts the data is called as
 - A. Bandwidth
 - B. Interlacing
 - C. Response time
 - D. Scanning
4. Manufacturing tolerance in FMS production technology is available as close ± 0.02 , whereas, tolerance that can be achieved in case of transfer line and CNC standalone production methodology will be
 - A. Lower tolerance for TL and higher for CNC standalone
 - B. Same as in case of FMS technology
 - C. Same tolerance for TL and higher for CNC standalone manufacturing
 - D. Something else
5. "Automatic placement and withdrawal of parts and products into and from designated places in a Warehouse" describes
 - A. AGV
 - B. CAD/CAM
 - C. CIM
 - D. ASRS
6. For Cohen-Sutherland window clipping algorithm, the extreme left top corner of the window will have the code
 - A. 1001
 - B. 0100
 - C. 0010
 - D. 1010
7. Which type of motor is NOT used in axis r spindle drive of CNC machine tool
 - A. D.C servo motor
 - B. Induction motor
 - C. Step-up motor
 - D. Linear servo motor
8. G03 in Fanuc control system is
 - A. Linear interpolation
 - B. Circular interpolation anticlockwise
 - C. Circular interpolation clockwise
 - D. Dwell

9. Suppose that the transformation has given by the matrix M is

$$M = \begin{pmatrix} 1 & 2 & 1 \\ 3 & 4 & 1 \\ 2 & 5 & 3 \end{pmatrix}$$

The image of the point $(3, -1)$ after transformation will be

- A. $(0, 2, 7/5)$
 - B. $(2, 2, 1)$
 - C. $(2/5, 7/5, 1)$
 - D. $(5/2, 5/7, 1)$
10. The LVDT is primarily used for the measurement of
- A. Displacement
 - B. Velocity
 - C. Acceleration
 - D. Humidity
11. The equation $2S^4 + S^3 + 3S^2 + 5S + 10 = 0$ have roots in the left half of S-plane.
- A. One
 - B. Two
 - C. Three
 - D. Four
12. The steady-state error of a feedback control system with an acceleration input becomes finite in a
- A. Type 0 systems.
 - B. Type 1 system.
 - C. Type 2 systems.
 - D. Type 3 system.
13. In h-method of FEA
- A. Size of the element is changed
 - B. Type of the element is changed.
 - C. Order of the element is changed.
 - D. None of the above
14. The concept of inheritance provides the idea of _____.
- A. Taking more than one form
 - B. reusability
 - C. data hiding
 - D. All of the above
15. Which method registers a thread in a thread scheduler?
- A. `run()`
 - B. `constructor()`
 - C. `start()`
 - D. `register()`

16. Which of the following is NOT popularly used as 3D modelling software
- A. UGX
 - B. IDEAS
 - C. ANSYS
 - D. Pro-E
17. Which process is of liquid based rapid prototype
- A. Stereo lithography (SLA)
 - B. Selective laser sintering(SLS)
 - C. Fused deposition modelling FDM
 - D. Laminated object manufacturing
18. If a class C is derived from class B, which is derived from class A, all through public inheritance, then a class C member function can access
- A. Protected and public data only in C and B.
 - B. Protected and public data only in C.
 - C. Private data in A and B.
 - D. Protected data in A and B.
19. Any problem statement should include all of the following except:
- A. Input.
 - B. Output.
 - C. Processing.
 - D. Storage.
20. Identify the wrong statement
- A. The global stiffness matrix is the assemblage of all local stiffness matrices and define the stiffness of the entire system
 - B. Connectivity related to the manner in which one element in a finite element model is connected with an adjacent element
 - C. Neumann boundary condition correspond to the problem where both boundary condition do not specify for the first derivative
 - D. The term direct method is sometimes used to describe the development of a finite element using concepts from matrix analysis structure

SECTION-II

Q1. Explain (Any three 3X10=30)

- a. Strategies of Automation
- b. Group technology-“A base for implementation of CIM”
-“An analogy with Object Oriented method”.
- c. Shape functions- its role, properties and significance in FEA
- d. Raster display vs. vector display technique
- e. Computer aided design/Computer aided manufacturing process
- f. Elaborate any research problem involving use of CAD/CAM/CAE tools/methods, with which you are familiar

SECTION-III

Q1. A manufacturing firm has recently discounted production of certain product, due to unfavourable market condition resulting in to considerable excess production capacity. The firm is planning to utilize the spare capacity by increasing the production of remaining one or more of the existing three products. The current available capacities are as given below,

Milling capacity = 300 machine hour/day

Lathe capacity = 225 machine hour/day

Grinder capacity = 100 machine hour/day

The number of machine hours required for each of the product given in the table below. The net profit released from the ‘product-A’, ‘Product-B’ and ‘products-C’ are Rs. 200, Rs. 90 and Rs. 100 respectively. The project manager interested to allocate the available capacity for maximum profit. Formulate the linear programming problem and solve.[15]

Machine type	Machine hours required		
	Product-A	Product-B	Product-C
Milling	12	03	04
Lathe	06	04	01
Grinding	03	01	02

Q2. Explain the ways to obtain Element Matrix Equation by considering suitable examples, [15]
differential equation with suitable boundary condition pertaining to any field problem and how it could be used as a generalization for different field problems.

Q3. a) Sketch the root locus of the system-

$$G(s)H(s) = \frac{k}{S(S+2)(s+5)} \quad [10M]$$

And determine the value K for:-

- i. Critical damping
- ii. Marginal stability from the root locus

b) Explain graphic standards.

[05]

Q4. a) Explain computer integrated manufacturing environment in details by focussing on the [10]
issues/ problems in the integration of system

b) Explain Hidden line /Hidden surface algorithms (Any two)

[05]

STREME: Manufacturing Engineering**SECTION - I**

- 1) Which is false statement about annealing. Annealing is done to
 - a) Release stresses
 - b) harden steel slightly
 - c) Improve machining characteristic
 - d) soften material
 - d) Permit further cold working
- 2) Thermosetting plastics are plastics that can be
 - a) Remoulded
 - b) Cannot be remoulded
 - c) Not affected by heat
 - d) Repeated heating and setting takes place
- 3) Tensile testing is done to find out the characteristics of a metal or alloy such as
 - a) Yield strength
 - b) Young modulus
 - c) Tensile strength
 - d) All of the above
- 4) Polyurethane rubber is produced from the chemicals
 - a) Urea and ammonia
 - b) Diol and Di-isocyanate
 - c) Diol and styrene
 - d) Diol and acrylonitrile
- 5) Which of the following welding process uses non-consumable electrode
 - a) LASER welding
 - b) MIG welding
 - c) TIG welding
 - d) Ion beam welding
 - e) Plasma welding
- 6) In bending operation, the metal takes shape of
 - a) Die
 - b) Punch
 - c) Average of two
 - d) Could take any shape
 - e) None of the above
- 7) In piercing and punching operations, the angle of shear is provided on
 - a) Die
 - b) Punch
 - c) Both on punch and die
 - d) Not provided at all
 - e) None of the above

- 8) Which of the following properties are essential for a tool material
- Red hardness and impact resistance
 - Red hardness and wear resistance
 - Toughness and impact resistance
 - Impact resistance and wear resistance
 - Red hardness, wear resistance and toughness
- 9) **Metal in machining operation is removed by**
- Tearing chips
 - Distortion of metal
 - Shearing the metal across a zone
 - Cutting the metal across a zone
 - Pushing the metal with tool
- 10) In orthogonal cutting system, the cutting edge is
- In line with direction of tool travel
 - Perpendicular to direction of tool travel
 - Perpendicular to shear plane
 - Perpendicular to direction of depth of cut
 - none of above
- 11) The linear programming techniques can be applied successfully to industries like
- Iron and steel
 - Food processing
 - Oil and chemical
 - Banking
 - All of the above
- 12) In sheet metal work, the cutting force on the tool can be reduced by
- Grinding the cutting edges sharp
 - Increasing the hardness of tool
 - Providing shear angle on tool
 - Increasing the hardness of die
- 13) Match List I (Methods) with List II (Problems) and select the correct answer using the codes given below the lists:

List I

- A Moving average
- B Line balancing
- C Economic lot size
- D Johnson algorithm

List II

- 1. Assembly
- 2. Purchase
- 3. Forecasting
- 4. Sequencing

- 1 3 2 4
- 1 3 4 2
- 3 1 4 2
- 3 1 2 4

- 14) Time estimates of an activity in a PERT network are: Optimistic time $t_o = 9$ days; pessimistic time $t_p = 21$ days most likely time $t_m = 15$ days
The approximate probability of completion of this activity in 13 days is
- 16%
 - 34%
 - 50%
 - 84%
- 15) In a machining operation, chip thickness ratio is 0.3 and the back rake angle of the tool is 10° . What is the value of the shear strain?
- 0.31
 - 0.13
 - 3.00
 - 3.34
- 16) It is given that the actual demand is 59 units, a previous forecast 64 units and smoothing factor 0.3. What will be the forecast for the next period, using exponential smoothing.
- 36.9 units
 - 57.5 units
 - 60.5 units
 - 62.5 units
- 17) In order that linear programming techniques provide valid results
- Relations between factors must be linear (positive)
 - Relations between factors must be linear (negative)
 - 'a' or 'b'
 - Only one factor should change at a time, others remaining constant
 - None of the above
- 18) The linear programming techniques can be applied successfully to industries like
- Iron and steel
 - Food processing
 - Oil and chemical
 - Banking
 - All of the above
- 19) Economic Order Quantity is the quantity at which the cost of carrying is
- Minimum
 - Equal to the cost of ordering
 - Less than the cost of ordering
 - Cost of over-stocking
- 20) Tool life is most affected by
- Cutting speed
 - Tool geometry
 - Feed and depth
 - Microstructure of material being cut
 - Not using coolant and lubricant

SECTION – II

- 1 (a) Explain, with suitable illustrations and citing the practical examples, how products could be innovated.
- (b) What is 'Rapid Prototyping'? Explain with suitable diagram 'Selective Laser Sintering'.
- 2) What do you understand by 'Product Specifications'? Explain the following contents of product design specifications:
 - (i) Quality and reliability
 - (ii) Market constraints
 - (iii) Safety.
- 3) a) What is innovation? What is the need for innovation? Discuss about some of the innovated products.
- (b) Explain with a suitable illustration, the concept of 'Product Life Cycle'.
- 4) List the characteristics of manufacturing systems and write brief notes on: OLAC's and AGVS
- 5) a) Distinguish between P-system and Q-system in Inventory control
- b) What is the distribution followed by the activity durations of a PERT network? Mention its mean and standard deviation.
- 6) Explain with application of effects of polymers in environment

SECTION – III

- 1) (a) What is the Design for Manufacturability/Assembly (DFMA)? Elaborate the guidelines for DFMA.
- (b) Explain the DFA index. How to determine the 'theoretical minimum number of parts'?
- (c) How do the factors:
 - (i) Product quality
 - (ii) Product cost and
 - (iii) Development time, play an important role in successful product development?
- 2) Explain the five drivers of Supply chain and queuing system with example
- 3) From the following table, determine: 10
 - (i) Return on sales
 - (ii) Return on investment.
 Also, provide your comments on the results.

End of year	Estimated sales (\$)	Cost of sales (\$)
1	5,000	20,000
2	22,000	12,000
3	35,000	17,000
4	40,000	20,000
5	62,000	35,000
6	75,000	42,000
7	80,000	43,000
8	40,000	22,000
9	22,000	12,000
10	10,000	8,000

- 4) a) What is the difference between CPM and PERT techniques
- b) Derive an expression for EOQ