2013-14
(ATKT)

QP Code : MV-18431

(3 Hours)

[Total Marks : 100

N.B. : (1) Question **No.1** is **compulsory**.
(2) Solve any **four** out of remaining **six** questions.
(3) **Assume** suitable data if required.
(4) Draw neat sketches wherever necessary.

1. (a) What is drift? Explain the different types of drift with sketches of input-output relationship in each case.   5

    (b) Explain the construction and working of Toolmaker's microscope.   5

    (c) Define fit and classify it depending upon the actual limits of hole or shaft. Give examples of each type of it.   5

    (d) A strain gauge is bonded to a beam 0.1 m long and has a cross-sectional area 4 cm². Young's modulus of elasticity for steel is 207 GN/m². The strain gauge has an unstrained resistance of 240Ω and a gauge factor of 2.2. When a load is applied, the resistance of gauge changes by 0.013 Ω. Calculate the change in length of the steel beam and the amount of force applied to the beam.   5

2. (a) What are 'Desired', 'Modifying' and 'Interfering' inputs for measurement system? Give examples for each of these. Draw a block diagram for showing their influence on the output.   10

    (b) Explain the three wire method for checking the pitch diameter of screw.   10

3. (a) A small cantilever beam is constructed for measurement of force 'F'. It is made of spring steel having modulus of elasticity E = 200×10⁹ N/m². The beam is 4.75 mm wide and 0.9 mm thick with a length of 25 ± 0.025 mm. An LVDT is used for displacement sensing device. It is estimated that the limiting error in displacement measurement is ± 0.025 mm.   10

    Calculate the value of force and the limiting error if the displacement of LVDT is 2.2 mm. The limiting error in bar dimensions (in width and thickness) is ± 0.0075 mm.

    $$F = \frac{3EIx}{L^3}$$

    Given force,

    Where,   I = Moment of inertia of beam, m⁴
           L = Length of beam, m
           x = Displacement of LVDT, m

    (b) Explain use of slip gauges. Describe the measurement of cone angle of taper plug gauge by using sine bar.   10

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4. (a) Explain the working of Nozzle Flapper Transducer.   5
   (b) Discuss the elements of surface roughness.   5
   (c) Write short note on (any **two**) :—   5
         (i)   Auto -Collimator
         (ii) Bridgeman's Gauge
         (iii) Load cell

5. (a) Explain displacement measurement with potentiometer and LVDT.   8
   (b) A diaphragm gauge is constructed of spring steel to measure differential pressure   7
       of 7 MN/m² . The diameter of diaphragm is 12.5 mm. Calculate the thickness of
       diaphragm, if the maximum deflection is 0.33 of thickness. Also calculate the natural
       frequency of diaphragm.

       Given,   Young's modulus   = 200 GN/m²
                 Poisson's ratio   = 0.28
                 Density of steel   = 7800 Kg/m³

   (c) Write a short note on pyrometer.   5

6. (a) While measuring speed of turbine with stroboscope single line images were observed   5
       for stroboscope setting of 2400, 3800, and 6000 rpm. Calculate the speed of the
       turbine.
   (b) Differentiate between line standards and end standards.   5
   (c) Write short note on (any **two**) :—   10
         (i)   McLeod Gauge
         (ii) Accelerometer
         (iii) Interchangeability and its importance.

7. (a) Compare thermoelectric sensors on the basis of basic principle of working, materials   10
       used, characteristic behavior, range of operation and their types available.
   (b) In a hole and shaft assembly of 30 mm nominal size the tolerances for hole and shaft   10
       are as specified below.

$$\text{Hole :} 30^{+0.020}_{-0.000} \text{ mm}, \quad \text{Shaft :} 30^{-0.040}_{-0.070} \text{ mm}$$

   Determine :—
         (i)   Maximum and minimum clearance obtainable.
         (ii) Allowance.
         (iii) Hole and shaft tolerance.
         (iv) Maximum metal limit (MML) for shaft and hole.
         (v) Type of fit.

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(3 Hours)   [Total Marks : 100

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       relationship in each case.

    (b) Explain the construction and working of Toolmaker's microscope.   5

    (c) Define fit and classify it depending upon the actual limits of hole or shaft. Give   5
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    (d) A strain gauge is bonded to a beam 0.1 m long and has a cross-sectional area 4 cm².   5
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       resistance of 240Ω and a gauge factor of 2.2. When a load is applied, the resistance
       of gauge changes by 0.013 Ω. Calculate the change in length of the steel beam and the
       amount of force applied to the beam.

2. (a) What are 'Desired', 'Modifying' and 'Interfering' inputs for measurement system?   10
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       measurement is ± 0.025 mm.

       Calculate the value of force and the limiting error if the displacement of LVDT is
       2.2 mm. The limiting error in bar dimensions (in width and thickness) is
       ± 0.0075 mm.

       Given force, $F = \dfrac{3EIx}{L^3}$

       Where,   I = Moment of inertia of beam, m⁴
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    (b) Explain use of slip gauges. Describe the measurement of cone angle of taper plug   10
       gauge by using sine bar.

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(3 Hours) [Total Marks : 100

N.B. : 1) Question No. 1 is compulsory.

2) Attempt any four questions out of the remaining six questions.

3) Assume suitable data wherever necessary.

1) Explain any four :- (20)
   a) With the help of neat sketch explain the working of a shoe brake.
   b) Describe the function of a simple Watt governor. What are its limitations?
   c) Which of the two assumptions, uniform intensity of pressure or uniform rate of wear would you make use of in designing friction clutch and why?
   d) Explain with a neat sketch sun and planet wheel.
   e) With a neat sketch, define the following term as applied to cam,

   i) Base circle   ii) Pitch circle   iii) Pressure angle   iv) Stroke of the follower.

2) a) A single plate clutch is required to transmit 8 kW at 1000 rpm. The axial pressure is (10) limited to 70 kN / m^2. The mean radius of the plate is 4.5 times the radial width of the friction surface. If both the sides of the plate are effective and the coefficient of friction is 0.25, find the i) inner and outer radii of the plate and the mean radius ii) width of the friction lining.

   b) A band and block brake, with 15 blocks, each of which subtends an angle of 15^0, is (10) applied to a drum of 1 m diameter as shown in the **Figure**. The drum and the flywheel mounted on the same shaft has a mass of 1500 kg and a combined radius of gyration of 500 mm. Find i) maximum braking torque ii) angular retardation of the drum and iii) time taken by the system to come to rest from the rated speed of 380 rpm. The coefficient of friction between the drum and the blocks can be taken as 0.25.
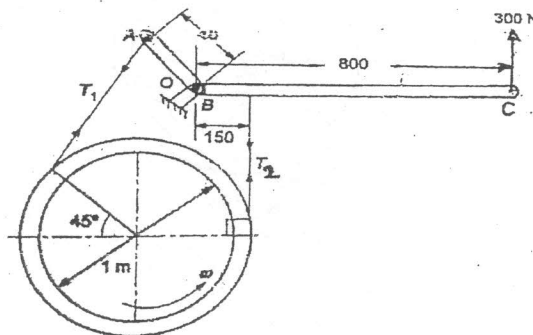
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3) a) In a Hartnell governor, the mass of each ball is 1 kg, length of vertical arm of the bell crank lever is 100 mm and that of the horizontal arm is 50 mm. The distance of fulcrum of each bell crank lever is 80 mm from the axis of rotation of the governor. The extreme radii of rotation of the balls are 75 mm and 112.5 mm. The maximum equilibrium speed is 5 % greater than the minimum equilibrium speed which is 360 rpm. Find, neglecting obliquity of arms, initial compression of the spring and equilibrium speed corresponding to the radius of rotation of 100 mm.

b) The mass of a turbine rotor of a ship is 8000 kg and has a radius of gyration of 0.75 m. It rotates at 1800 rpm clockwise when viewed from the stern. Determine the gyroscopic effects in the following cases:

    i) If the ship traveling at 100 km/h steers to the left along a curve of 80 m radius.

    ii) If the ship is pitching and the bow is descending with maximum velocity. The pitching is with SHM with periodic time of 20 s and the total angular movement between extreme positions is 10^0.

    iii) If the ship is rolling with an angular velocity of 0.03 rad/s clockwise when looking from stern.

In each case determine the direction in which the ship tends to move.

4) a) With the help of neat sketches classify cams in detail.

b) **Figure** shows a compound epicyclic gear train. Wheels A , D and E are free to rotate independently on spindle O, while B and C are compound and rotate together on spindle P, on the end of arm OP. All the teeth on different wheels have the same module. A has 12 teeth, B has 30 teeth and C has 14 teeth cut externally. Find the number of teeth on wheels D and E which are cut internally. If the wheel A is driven clockwise at 1 rps. While D is driven counter clockwise at 5 rps, determine the magnitude and direction of the angular velocities of arm OP and wheel E.
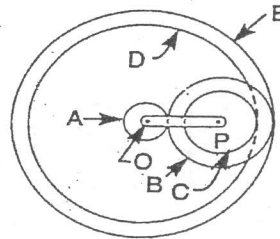
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5) a) A cam with 30 mm as minimum diameter and 20 mm lift is rotating clockwise at a uniform speed of 1200 rpm and has to give following motion with uniform acceleration and retardation motion; Outward stroke during 120^0, Dwell for 60^0, Return during 90^0 and Dwell for the remaining period. Draw the displacement, velocity and acceleration diagram during the ascent and return strokes.   (10)

b) With the help of neat sketch explain centrifugal clutch and derive the equation of torque transmitted for the same.   (10)

6) a) A two wheeler motor vehicle and its rider weigh 130 kg and their combined center of gravity is 750 mm above the ground level when the vehicle is upright. Each road wheel is 600 mm diameter and has M.I. of 1.2 kg-m^2 about its axis of rotation. The rotating parts of the engine have M.I. of 0.4 kg-m^2. The engine rotates at 5 times the speed of the road wheels and in the same sense. When the vehicle is rounding the curve of 130 m radius at a speed of 60 km/h, Determine i) magnitude of total gyroscopic couple acting on vehicle and ii) angle of banking so that there will be no tendency of side slip.   (10)

b) List the types of brakes. With the help of neat sketch explain the working of internal expanding shoe brake. What do you mean by leading and trailing shoes?   (10)

7) Write short notes on (Any four):-   (20)
   a) Rope brake dynamometer
   b) Inertia governor
   c) Reverted gear train
   d) Pressure angle and methods to control it with respect to cam
   e) Differentiate between governor and flywheel.

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(3 Hours)   [Total Marks : 100

N. B. : 1. Question no.1 is compulsory.
    2. Attempt any **FOUR** from question no. 2 to 7.
    3. Use illustrative diagrams wherever required.

Q1) **a)** What do you mean by boundary layer and boundary layer thickness?   05
    b) What is pitot tube? On what principle does it works?   05
    c) Two horizontal plates are placed 1.25 cm apart, the space between them being 05 filled with oil of viscosity 14 poise. Calculate the shear stress in oil if upper plate is moved with a velocity of 2.5 m/s
    d) The barometric pressure at sea level is 760 mm of mercury while that on a 05 mountain top is 725 mm , if the density of air is assumed constant at 1.19 kg/m³, what is the elevation of the mountain top.

Q2) **a)** A sliding gate 3m wide and 1.5m high situated in a vertical plane has a 10 coefficient of friction between itself and guide of 0.18. If the gate weight is 19 kN and if its upper edge is at a depth of 9 m, what vertical force is required to raise it? Neglect buoyancy force on gate
    b) Using the laminar boundary layer velocity distribution: 10

$$\frac{u}{U} = 2\left(\frac{Y}{\delta}\right) - \left(\frac{Y}{\delta}\right)^2$$

    i) Check if boundary layer separation occurs.
    ii) Determine Boundary layer thickness (In terms of Re)

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Q3) **a)** Derive Euler's equation for three dimensions.   12

b) An oil of specific gravity 0.8 flows upwards through a vertical pipe. A & B are   08
two points in the pipe, B being 30 cm higher than A. Connections are led from A
& B to a U- tube containing mercury. If the difference of pressure between A &
B is 0.18 kg/cm². Find the reading shown by the differential manometer.

Q4) **a)** Starting from Navier stokes equation for incompressible laminar flows derive an   10
equation for velocity profile for Couette flow. State the assumptions made

b) Derive Darcy-weisbach equation and state its utility   10

Q5) **a)** Explain Reynold's transport theorem with its proof   10

b) A liquid of viscosity of 0.88 poise is filled between two horizontal plates 10 mm   10
apart. If the upper plate moving at 1.1 m/s with respect to lower plate is
stationary and pressure difference between the two sections 60 m apart is 60
KN/m² , determine:
   i) Velocity distribution
   ii) Discharge per unit width, and
   iii) Shear stress on the upper plate

Q6) **a)** Three pipes of diameters 300 mm, 200 mm & 400 mm and lengths 450 m, 255 m   10
& 315m respectively are connected in series. The difference in water surface
levels in two tanks is 18 m. Determine the rate of flow of water if coefficients of
friction are 0.0075, 0.0078 & 0.0072 respectively (consider minor losses)

b) A uniform flow of velocity 6 m/s is flowing along x axis over a source & sink   10
which are situated along x axis. The strength of source and sink is 15 m²/s and
they are at a distance of 1.5 m apart. Determine
   i) Location of stagnation points
   ii) Length & width of the Rankine oval
   iii) Equation of profile of the Rankine body

Q7) **a)** Distinguish between (any three)   12
   i) Streamlined and Bluff bodies
   ii) Implicit and Expilict schemes
   iii) Structured and Unstructured grid
   iv) Finite Volume Method and Finite Difference Method

b) Write short note on the following   08
   i) Elbow Meter
   ii) Moody's Diagram

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(2 Hours)   [Total Marks : 50

N. B. : (1) Question No. 1 is **compulsory**.
     (2) Attempt any **four** questions from question No. **2** to 7.
     (3) **Figures** to the **right** indicate **full** marks.
     (4) Draw suitable diagrams wherever required.

1. Attempt any **five** of the following :—   10
   (a) With suitable example, explain the energy flow in any ecosystem.
   (b) How Ex-situ conservation of biodiversity is carried out?
   (c) Why value education is important for better environment?
   (d) Explain the causes and effects of thermal pollution.
   (e) Why wasteland management is important?
   (f) What are the limitations of conventional sources of energy?
   (g) Explain the term 'sustainable development.'

2. (a) What are our forest resources? Explain the reasons for depletion of forest resources?   5
   (b) What is population explosion? What are the effects of growing population on enviornment?   5

3. (a) Explain briefly characteristic features and functions of grassland ecosystem.   5
   (b) What are the causes and effects of global warming?   5

4. (a) Why conservation of water is important? Explain briefly how watershed management is carried out?   5
   (b) What are the problems of women and children in India? What is being done for their welfare?   5

5. (a) What role an individual can play in preventing the pollution?   5
   (b) What are the causes and effects of water pollution?   5

6. (a) Explain the salient of features of water pollution prevention act.   5
   (b) List any four important air pollutants. Explain the effects caused on account of them.   5

7. (a) How solid waste management is done?   5
   (b) What role is played by Information Technology to the field of Health and Environment?   5

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