(OLD COURSE)   Q.P. Code : 11970

(3 Hours)   [Total Marks : 100

N.B. : (1)   Question No. **1** is **compulsory**.
(2)   Attempts any **four** from remaining six questions.
(3)   Assume suitable data if necessary.
(4)   **Figures** to the right indicate **full** marks.

1   Explain any four :–   20
    (a)   Internal Expanding brake
    (b)   Importance of pressure angle of a cam
    (c)   Centrifugal clutch
    (d)   Gear Train Classification
    (e)   Limitation of Watt Governor.

2. (a)   Derive an expression for Gyroscopic acceleration from first principle.   6
  (b)   Explain "Cam Terminology".   4
  (c)   A multiplate clutch transmits 55KW of power at 1800 rpm. the co-efficient of   10
     friction is 0.1. The inner radius is 80mm and is 0.65 times the outer radius. If the
     intensity of pressure is not to exceed $160KN/m^2$, determine the number of pair of
     friction surfaces needed to transmit the required torque.

3. (a)   The controlling force curve of a spring controlled governor is straight line. The   10
     weight of each ball is 40N and extreme radii of rotation are 120mm and 180mm.
     If the values of the controlling force at the above radii be respectively 200N and
     360N and the friction of the mechanism is equivalent to 2N at each ball, find.
       (i)   The extreme equilibrium speed of Governor.
       (ii)   Equilibrium speed
       (iii)   The co-efficient of insensitiveness at radius of 150mm

  (b)   Derive an expression for road reaction in case of a four wheeler with brakes   10
     applied on :
       (i)   The rear wheels only
       (ii)   The front wheels only
       (iii)   All the four wheels

4. (a)   In epicyclic gear train is composed of a fixed annular wheel A having 150 teeth.   10
     Meshing with A is a wheel B, which drives wheel D through an idler wheel C, D
     being concentric with A. Wheels B and C are carried on an arm which revolves
     clockwise at 100 rpm about the axis of A and D. If the wheel B and D have 25
     teeth and 40 teeth respectively. Find the number of teeth of gear C and the speed
     sense of rotation of gear C.

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(b) With the help of a neat sketch explain any one type of transmission Dynamometer.   6

(c) Classify brakes.   4

5. (a) Derive an expression for effort and power of Porter Governor.   10

   (b) Derive an expression for angle of heel in case of a two wheeler negotiating a turn.   10

6. (a) Draw displacement, velocity, acceleration and jerk diagrams of cam operating a knife edge follower from the following data.   16

      (i) Follower move to rise through 40mm during 90° rotation of cam with SHM.

      (ii) Follower to dwell for next 45° rotation of cam.

      (iii) Follower to return to its original position during next 120° rotation with UARM.

      (iv) Follower to dwell for remaining period.

   (b) Explain effect of Gyroscopic couple on an Aeroplane.   4

7. (a) Explain following terms with reference to a Governor.   10

      (i) Sensitiveness

      (ii) Hunting

      (iii) Isochronism

      (iv) Stability

      (v) Co-efficient of insensitiveness.

   (b) A disc of 5kg mass with radius of gyration 70mm is mounted at mid-span on a horizontal shaft of 120mm length between two bearings. The shaft spins at 720rpm in clockwise direction when viewed from the right hand side bearing. If the shaft precesses about the vertical axis at 30rpm in clockwise direction when viewed from the above, determine the reactions at each bearing due to mass of the disc and gyroscopic effect.   10

(3 Hours) [Total Marks : 80

N.B. : (1)   Question No. **1** is **compulsory**.
        (2)   Solve any **three** out of **remaining** questions.
        (3)   Assume **suitable data** if **required** and mention it **clearly**.

1. (a) Differentiate between precision and accuracy with suitable examples.   5
   (b) What are objectives of quality control ?   5
   (c) What are limitations and advantages of pneumatic comparators ?   5
   (d) Explain concept of Waviness and Roughness.   5

2. (a) A hole and shaft assembly designed as H7S6, having nominal diameter 32 mm is   10
        being manufactured. The gauges for components inspection are proposed on the
        basis of following information (All values in microns)
        Hole :   T = 25   H = 4   Z = 3.5   Y = 3
        Shaft : T_1 = 16 H_1 = 4 Z_1 = 3.5 $Y_{1=3}$ F.D. = 43
        Show dispersion of tolerance on gauges.
   (b) Explain construction and working of Parkinson Gear tester in detail.   10

3. (a) Explain the phenomenon of interference of light. Explain briefly how it can be   10
        applied in flatness measurement of surface.
   (b) Define and classify various types of cost of quality with suitable examples.   10

4. (a) With the help of graphical presentation, explain following parameters used in surface   10
        texture measurement :—   10
             (i) R_a (ii) R_y (iii) R_z (iv) Sampling length
   (b) "If all points on X bar chart and R-chart lies within UCL and LCL then all parts   10
        should be accepted".
        Do you agree with above statement ? If yes why? If not why ?

5. (a) Explain two wire method used in screw thread measurement.   10
   (b) Explain P and nP charts with their applications.   10

6. (a) Pins are supplied in lots of 5000. As per the sampling inspection procedure agreed   10
        between the vendor and company, sample size 50 is taken. If maximum two pin are
        defective, the entire lot is accepted otherwise rejected
             (i)   What is the probability that a lot containing 3% defective is accepted ?
             (ii)   If AQL = 2%, what is producers risk
             (iii) If LTPD = 5%, what is consumers risk ?
             (iv)   Sketch OC curve.
   (b) Explain construction and working and applications of profile projector.   10

————— v —————

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Q.P. Code : 14809

(3 Hours)   [Total Marks : 80

N.B. : (1)   Question No. 1 is compulsory.
(2)   Attempt any three questions out of the remaining five.
(3)   Assume suitable data if necessary but justify the same.
(4)   Figures to the right indicate full marks.

Q1.   Attempt any four   (20)

A.   How does a clutch differ from that of a brake?

B.   Explain the controlling force diagram for a spring controlled governor.

C.   Derive the equation for the gyroscopic couple on a naval ship during pitching.

D.   What do you mean by gear train? List down all the types of gear train and give one application of each.

E.   Determine the minimum value for the radius ratio R_2 / R_1 of a single plate clutch at which the capacity of clutch will decrease by not more than 10 % during the initial wear period.

Q2 A.   A plate clutch has three discs on the driving shaft and two discs on the driven   (7) shaft. The inside and the outside diameters of the friction surfaces are 125 mm and 250 mm respectively. Assuming uniform pressure and coefficient of friction equal to 0.3, find the total spring load pressing the plates together to transmit 30 kW at 1500 rpm.

B.   A simple band brake is applied to a shaft carrying a flywheel of mass 250 kg and   (7) radius of gyration 300 mm. The shaft speed is 200 rpm. The drum diameter is 200 mm and the coefficient of friction is 0.25. The free end of band is attached at 100 mm from the fulcrum and effort of 120 N is applied on lever at 280 mm on the other side of the fulcrum. The angle embraced by belt is 225°. Determine for counter clockwise rotation of drum i) Braking torque ii) The number of turns of flywheel before it comes to rest.

C.   What do you mean by a dynamometer? Classify the same. How does a   (6) dynamometer differ from a brake?

Q3 A.   For a spring controlled Hartnell type governor, following data is provided:-   (7)
Mass of the governor ball = 1.80 kg
Length of the vertical arm of the bell crank lever = 8.75 cm
Length of the other arm of bell crank lever = 10 cm
The speeds corresponding to radii of rotations of 12 cm and 13 cm are 296 and 304 rpm respectively. Determine the stiffness of the spring.

B.   A solid circular steel disc 250 mm diameter and 50 mm thick is mounted with its   (7) polar axis on the line OX, of the three Cartesian axes OX, OY and OZ. If at a particular instant the disc is spinning about OX at 12 rad/sec in anticlockwise direction when viewed from right hand side and the frame is rotated at 5 rad/sec about OY in anticlockwise direction when viewed from top, determine the magnitude and sense of the gyroscopic couple. Density of the steel may be taken as 7.8 gm/cc.

C.   With the help of neat sketch explain the following terms with respect to   (6) gyroscope i) Spin plane ii) Precession axis iii) Gyroscopic plane

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Q4 A. Two shafts A and B are co-axial. A gear C having 50 teeth is rigidly mounted on (7) shaft A. A compound gear D-E gears with C and an internal gear G. D has 20 teeth and gears with C and E has 35 teeth and gears with an internal gear G. The gear G is fixed and is concentric with the shaft axis. The compound gear D-E is mounted on a pin which projects from an arm keyed to the shaft B. Find the number of teeth on the internal gear G assuming that all the gears have the same module. If the shaft A rotates at 110 rpm find the speed of the shaft B.
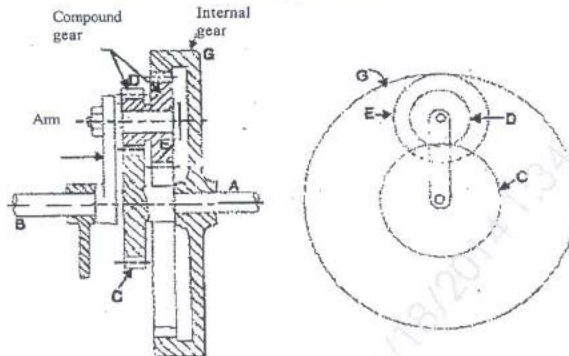

B. A riveting machine is driven by a constant torque 3 kW motor. The moving parts (7) including the flywheel are equivalent to 150 kg at 0.6 m radius. One riveting operation takes 1 second and absorbs 10000 N-m of energy. The speed of the flywheel is 300 rpm before riveting. Find the speed immediately after riveting. How many rivets can be closed per minute?

C. Derive the equation for the correction couple to be applied to make two mass (6) systems dynamically equivalent.

Q5 A. The turning moment diagram for a four stroke gas engine may be assumed for (10) simplicity to be represented by four triangles, the areas of which from the line of zero pressure are as follows:

Suction stroke = 0.45×10^{-3} m²; Compression stroke = 1.7×10^{-3} m²; Expansion stroke = 6.8×10^{-3} m²; Exhaust stroke = 0.65×10^{-3} m². Each m² of area represents 3 MN-m of energy. All the areas except expansion stroke are negative. Assuming the resisting torque to be uniform, find the mass of the rim of a flywheel required to keep the speed between 202 and 198 rpm. The mean radius of the rim is 1.2 m.

B. A centrifugal clutch transmits 20 kW of power at 750 rpm. The engagement of (10) the clutch commences at 70 % of the running speed. The inside diameter of the drum is 200 mm and the distance of the centre of the mass of each shoe is 40 mm from the contact surface. Determine the
   i) mass of each shoe
   ii) net force exerted by each shoe on the drum surface
   iii) power transmitted when the shoe is worn 2 mm and is not readjusted.
Assume μ to be 0.25, number of shoes equal to 4 and the stiffness of the spring 150 kN/m.

[TURN OVER

Q6 A. A Porter governor has equal arms each 250 mm long and pivoted on the axis of (10) the rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the range of the speed, sleeve lift, governor effort and power of the governor in the following cases :-

    i) when the friction at the sleeve is neglected, and

    ii) when the friction at the sleeve is equivalent to 10 N.

B. An over drive for a vehicle consists of an epicyclic gear train as shown in the (10) figure, with compound planets B-C. B has 15 teeth and meshes with an annulus A which has 60 teeth. C has 20 teeth and meshes with the sun wheel D which is fixed. The annulus is keyed to the propeller shaft Y which rotates at 740 rad/sec. The spider which carries the pins upon which the planets revolve, is driven directly from main gear box by shaft X, this shaft being relatively free to rotate with respect to wheel D. Find the speed of shaft X, when all the teeth have the same module.
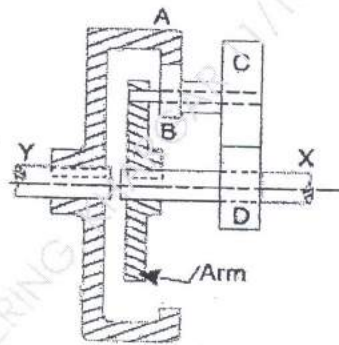
(OLD COURSE)   QP Code :12052

(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)   Solve **ANY FOUR**

   a)   What are the types of fluids? Describe Ideal fluid, Real fluid and Ideal Plastic 05
      fluid.

   b)   Explain the Terms: Path line, Streak line, Stream line, Steady flow and Uniform 05
      flow.

   c)   The head of water over an orifice of diameter 40 mm is 10 m. Find the actual 05
      discharge and actual velocity of the jet at vena-contracta.
      Take $C_d = 0.6$ and $C_v = 0.98$

   d)   What do you understand by major energy loss and minor energy losses in pipes? 05

   e)   What are the basic aspects of discretization in CFD 05

Q2) a)   Derive Euler's equation of motion for three dimensions. 12

   b)   An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe 08
      of diameter 200 mm at the rate of 60 liters/s. Find the head lost due to friction
      for a 500 m length of pipe. Find the power required to maintain this flow.

      Take coefficient friction, $f = \dfrac{0.079}{R_e^{0.25}}$

[TURN OVER

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Q3) **a)** Derive Darcy-weisbach equation and state its utility   10

b) A uniform flow of velocity 7 m/s is flowing along x axis over a source and sink   10
which are situated along x axis. The strength of source and sink is 18 m^2/s and
they are at a distance of 1.9 m apart. Determine
  i) Location of stagnation points
  ii) Length & width of the Rankine oval
  iii) Equation of profile of the Rankine body

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) Explain Reynold's transport theorem with its proof   10

Q5) **a)** Obtain Von Karman momentum integral equation   10

b) 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

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) i. A stream function is given by ψ = 5x-6y. Calculate the velocity components   05
and also magnitude and direction of the resultant velocity at any point.

ii. Discuss the phenomenon of boundary layer separation   05

Q7) **a)** i) Define. Source, Sink, Vortex, Circulation   04
ii) Write a note on Prandtl's mixing length theory   04
iii) Define Control Volume and Control Surface   04

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

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(OLD COURSE)

QP Code : 12112

(3 Hours)   [Total Marks :100

N.B. : (1)   Question No. **1** is **compulsory**.
       (2)   **Attempt** any **four** from remaining questions.
       (3)   Draw **suitable** sketches wherever **necessary**.

1. (a) What is double declutching? Sketch and explain synchromesh gear box and   **10**
         its advantages.
    (b) Describe the function, requirements and components of clutch-assembly.   **10**

2. (a) Differentiate between fluid fly-wheel and Torque-Converter with respect to their   **10**
         construction, working and application.
    (b) Name the different gears used in differential. Sketch and explain the functions   **10**
         of differential.

3. (a) Sketch and explain the wheel-cylinder and master-cylinder used in hydraulic   **10**
         braking system.
    (b) mention the types of leaf-springs. Draw and write about their applications.   **10**

4. (a) What is the necessity of wheel-alignment? Define the various terms related to   **10**
         steering geometry.
    (b) Sketch and explain various types of road-wheels and Hubs.   **10**

5. (a) Name the various four-wheel drive systems. Sketch and explain the arrangement   **10**
         of four-wheel drive-system.
    (b) Describe in brief about Automatic transmission and Epicyclic gear-box operation.   **10**

6. (a) Sketch and explain Rear-axle construction and write about Heavy vehicle rear-   **10**
         axle.
    (b) Explain the requirements of suspension. Sketch and explain any one types of   **10**
         suspension system.

7. Write short-notes on any **four** :—   **20**
        (a) Constant velocity joints
        (b) Tandem master cylinder
        (c) Air-brakes
        (d) Rack and pinion steering gear box
        (e) Brake lining materials.

LM-Con. 9897-14.

65

QP Code : 14889

(3 Hours)   [Total Marks : 80

N.B. : (1) Question number **one** is **compulsory**.
     (2) Attempt any **three** questions from remaining **five** questions.
     (3) Assume **suitable** data if **necessary** and state it **clearly**.

1. State whether following statements are **true** or **false** and justify :—   20
    (a) For same heat input and constant maximum pressure Otto cycle is better than diesel cycle.
    (b) Spark plug and exhaust valves are located away from each other inside combustion chamber of spark ignition engine.
    (c) Swirl instead of turbulence is required inside CI engine combustion chamber.
    (d) Specific fuel consumption for supercharged SI engine is more than naturally aspirated SI engine.
    (e) Higher the Octane number higher is the possibility of detonation.

2. (a) With neat sketch explain thermosyphon type water cooling system.   8
    (b) An Otto cycle with a compression ratio of 10 uses a fuel with a calorific value   12
of 48000 kJ/kg. The air fuel ratio is 15:1. The temperature and pressure at the end of suction stroke are 57°C and 1 bar respectively. Determine the maximum pressure in the cycle. The adiabatic index of compression is 1.36. The variation of specific heat at constant volume heat addition with respect to temperature is expressed as $C_v = 0.7117 + 2.1 \times 10^{-4}T$. If the C_v remains constant at 0.7117 kJ/kgK, together with adiabatic index, what would be the changes in the maximum pressure ?

3. (a) With neat sketch explain compression induced swirl and divided combustion   8
chamber. Also state its advantages and disadvantages.
    (b) The venturi of a simple carburetor has throat diameter of 35 mm and the coefficient   12
of air flow as 0.85. The fuel orifice has a diameter of 2.3 mm and the coefficient of fuel flow is 0.66. The petrol surface is 5 mm below the throat. Find
      1. The air fuel ratio for a pressure drop of 0.07 bar when the nozzle lip is nelected
      2. The air fuel ratio when the nozzle lip is taken into account
      3. The minimum velocity of air flow required to start the fuel flow when nozzle lip is provided
Take density of air and fuel as 1.2 and 750 kg/m³.

[TURN OVER

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4. (a) Compare detonation in SI and CI engine.   8

    (b) A four stroke cylinder gasoline engine has six cylinders of 80 mm bore and   12
100 mm stroke. The engine is coupled to a rope brake dynamometer having
a radius of 400 mm. At 3200 RPM with all cylinders firing the net load is
350 N. when each cylinder is cut off the average net brake load produced
at the same speed by the remaining five cylinders is 250 N. Estimate the indicated
mean effective pressure of the engine. With all cylinders in operation the fuel
consumption is 0.33 kg/hr. The calorific value of fuel is 43 MJ/kg. The cooling
water flow rate is 70 kg/min and the temperature rise is 10°C. During test
the engine is enclosed ina box and ventilating air is blown up through the
box at a rate of 15 kg/min at 17 °C. The air leaves the box at 62°C.
Draw heat balance sheet for the engine on minute basis.

5. (a) A six cylinder four stroke diesel engine operates at air fuel ratio of 20:1. The   10
diameter and stroke of the cylinder are 100 mm and 140 mm respectively.
The volumetric efficiency is 80 %. The condition of air at the beginning of
compression are 1 bar and 27°C. Determine the maximum amount of fuel that
can be injected in each cylinder per second. If the speed of the engine is
1500 RPM, injection pressure is 150 bar, air pressure during fuel injection
is 20 bar and the fuel injection is carried out for 20 degrees of crank rotation,
determine the diameter of fuel nozzle.

    (b) Describe in brief the methods of turbo charging.   10

6. Write a short note on (Any **four**) :—   20
    (a) Types of diesel fuel Injection nozzles
    (b) Use of ballast resistor and capacitor in ignition system
    (c) Variable compression ratio engine
    (d) SAE ratings of lube oils
    (e) Exhaust gas recirculation.

(3 Hours)   [Total Marks : 80

N.B :   (1) Question No.1 is compulsory.
        (2) Attempt any three questions from remaining six questions.
        (3) Assume suitable data if required.
   (4) Figures to the right indicate full marks.

1.   Write about any five :—   20
        (a)   Working of Screw Type Injection Molding.
        (b)   Principle and basic process parameters of Water Jet Machining.
        (c)   Applications of various types of Bushes used in jigs.
        (d)   Flexible Manufacturing Systems.
        (e)   Compound Die construction with sketch.
        (f)   Types of Automats.

2.   (a)   A symmetrical cup work-piece is shown in the figure. It is to be made from cold   10
           rolled steel, 1.2 mm thick. Make necessary calculations for designing the drawing
           die for this component. Determine the size of blank, percentage reduction, number
           of draws required, radius of punch and die, Drawing pressure if σ_{yt} = 430 N/mm^2.
           Take C = 0.67.
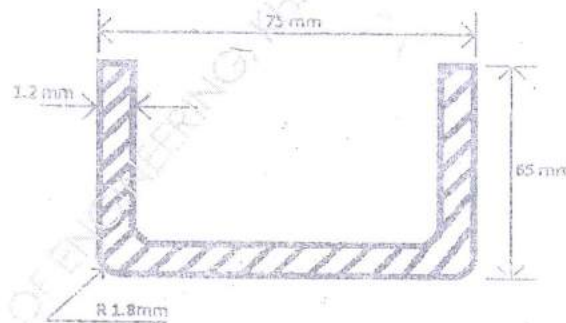
     (b)   What is Laser Beam Machining? Show its construction, working and applications   10
           with the help of diagram.

3.   (a)   Write about the different types of Runners and Gates used in Plastic Injection Molds   10
           with the help of diagrams.
     (b)   What are jigs used for? Show with the help of diagrams, the working of Pot jig, Box   10
           jig, Plate jig and Turnover jig.

[TURN OVER

2

4.   (a)   How is the 3-2-1 Location principle used for designing of Jigs and Fixtures?

      (b)   How are Transfer lines used in mass manufacturing? Also give its classification

      (c)   What is agile manufacturing? Show its need in the manufacturing industry.

5.   (a)   What is EDM? Write about its applications, advantages and limitations.

      (b)   Why is ejection system used in plastic injection molds? Write about Pin ejection method using a neat sketch.

      (c)   Write about the construction and working of progressive die and combination with the help of neat sketches.

6.   (a)   Write in detail about clamping and locating devices used in jigs and fixtures.

      (b)   How is Indexing mechanism used in fixtures? Show working of a sliding index fixture with the help of a diagram.

      (c)   How is classification of Non-traditional Machining done? Show the classification using a chart.

GN-Con. 9921-14.

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Mech
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Date: 10/12/14

QP Code : 14964

(3 Hours)

[Total Marks : 80

Instructions:

1) Question No 1 is compulsory
2) Answer any 3 from the remaining.
3) Assume suitable data if necessary.

Q-1   Answer any 4 questions.   20

a)   A rectangular slab (k = 10 W/m-K) of thickness 15 cm and inside temperature of 400°C is insulated by a materials of thickness 10 cm (K = 30W/m-K). The ambient air is at 28°C and the outside convective heat transfer coefficient is 15 W/m²K. Determine the steady state heat transfer per unit surface area and the temperature of outside surface of the slab and the insulation.

b)   In an oil cooler, oil (m=2500kg/hr and C_p = 1.9 kJ/kg-K)) at 160°C is cooled by water(m=1500 kg/hr and C_p =4.187 kJ/kg-K) entering at 35°C. Determine Capacity ratio, NTU and effectiveness if the overall heat transfer coefficient is 300 W/m²K. Assume parallel flow.

c)   A pipe, 2cm diameter, at 40°C is placed in (i) an air flow at 50°C with h = 20W/m²K OR in (ii) water at 30°C with h = 70W/m²K. Find the heat transfer per unit length of the pipe and comment on the results in both cases.

d)   Define Fin efficiency and Fin effectiveness. Explain in brief factors affecting fin effectiveness.

e)   What is the mode of heat transfer in Vacuum? Define absorptivity, reflectivity and transmissivity.

Q-2   a)   Water (mass = 1.4 kg/s , C_p = 4.187kJ/kg-K) is heated from 40°C to 70°C by   10
an oil (mass = 2 kg/sec, C_p =1.9 KJ/kg-K) entering at 110 °C in a counter flow heat exchanger. If overall heat transfer coefficient is 350 W/m²K, calculate the surface area required.

b)   Derive the temperature profile equation for a cylindrical system from the   10
general differential equation stating the assumptions for one dimensional steady state heat transfer.

Q-3   a)   A steel pipe of OD 0.15m lies 2m vertically and 8m horizontally in a large   10
room with an ambient temperature of 30°C. The pipe surface is at 250°C and has an emissivity of 0.6. Estimate the total heat loss (due to convection and radiation) from the pipe to the atmosphere. Properties at film temperature : v =27.8 x 10^{-6} m²/s, k =0.035 W/mK, Pr =0.684.
[Take Nu =0.13 (Gr.Pr)$^{1/3}$ if the flow is turbulent OR Nu =0.53 (Gr.Pr)$^{1/4}$ if the flow is Laminar.]

b)   What is lumped system analysis? When is it applicable?   4

c)   Draw a neat boiling curve for water and mark the different regions.   6

Q-4   a)   A furnace door, 1.5 m high and 1m wide is insulated from inside and has an   10
outer surface temperature of 70°C. If the surrounding ambient air is at 30°C calculate steady state heat loss from the door. Take the properties from at film temperature 50°C are ρ= 1.093Kg.m³, v =17.95 x 10-6 m²/s, Pr =0.698 Cp = = 1.005J/kg-K, use the correlation Nu =0.13 (Ra)$^{1/3}$

b)   A longitudinal copper fin (k=380W/m-K) 600 mm long and 5 mm diameter   6

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TURN OVER

is exposed to an air stream at 20°C. The convective heat transfer coefficient is 20 W/m²-K. If the fin base temperature is is 150°C, determine the rate of heat transfer and Fin efficiency.

c) How a radiation network is is constructed between two grey surfaces   4 exchanging radiant heat energy?

Q-5   a) With the help of Buckingham π-theorem show that for a forced convection   8 $Nu = C\ Re^m\ Pr^n$.

b) An 8 cm diameter Orange, approximately spherical in shape, undergoes   6 ripening process and generates 5000W/m³ of energy. If the external surface of the orange is at 6.5°C calculate the temperature at the center and also find the heat flow from the outer surface. Take k =0.22W/m-K for the orange. Assume steady state heat transfer.

c) A 3.2 mm stainless steel wire, 30 cm long has a voltage of 10 Volt impressed   6 on it. The outer surface temperature of the wire is maintained at 93°C. Calculate the center temperature of the wire. Take resistivity (ρ) of the wire as 70 x 10⁻⁸ ohm-m and the thermal conductivity as 22.5 W/mK.

Q-6   a) 10 mm OD pipe carries a cryogenic fluid at 80K. This pipe is encased by   10 another pipe of 15mm OD, and the space between them is evacuated. The outer pipe is at 280K. Emissivity of inner and outer surfaces is 0.2 and 0.3 respectively. (i) Determine the radiant heat flow rate over a pipe length of 5m. (ii)If a radiation shield of diameter 12mm and emissivity 0.05 on both sides is placed between the pipes, determine the percentage reduction in heat flow. (iii) What is the equilibrium temperature of the shield?

b) A spherical tank, 1 m in diameter is maintained at a temperature of 120°C   6 and exposed to a convection environment with h = 25W/m²-K and temperature of ambient is 15°C. What thickness of urethane foam (k = 20 x 10⁻³ W/m-K) should be added to ensure that the outer temperature of the insulation does not exceed 40°C? What percentage reduction in heat loss results from installing this insulation?

c) Define effectiveness and NTU of a heat exchanger.   4

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GN-Con. 10996-14.

(OLD COURSE)   **QP Code : 12132**

(3 Hours)   [Total Marks : 100

N.B. 1. Question no. **1** is compulsory.
      2. Answer any **four** from the remaining **six** questions.
      3. Assume suitable data wherever necessary.
      4. Figure to the right indicates full marks.

1 Answer any **five** of the following :   20
   (a) Explain the physical significance of Thermal Diffusivity
   (b) Write the second boundary condition for Finite Fin with insulated end, and Fin of infinite length.
   (c) State and prove Kirchoff's law of radiation.
   (d) Explain the significance of "Time constant" related to transient heat conduction.
   (e) What is the physical significance of Reynolds number and Nusselt number ?
   (f) Explain bulk mean temperature and correction factor related to Heat exchangers.

2(a) Derive Fourier's three dimensional differential equation in the Cartesian coordinates and hence deduce expression for one dimensional steady state heat conduction   10

 (b) An electric hot plate is maintained at a temperature of 350^0C and is used keep a solution boiling at 95^0 C. The solution is contained in a cast iron vessel of wall thickness 25 mm which is enameled inside to a thickness of 0.8 mm. The heat transfer coefficient for the boiling solution is 5.5 kW/ m^2 K and thermal conductivities of cast iron and enamel are 50 and 1.05 W/ mK respectively.
Calculate 1) the overall heat transfer coefficient.
2) the rate of heat transfer per unit area.   10

3 (a) Derive an expression for logarithmic mean temperature difference of Parallel flow heat exchanger and state the assumptions clearly   8
 (b) The flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperature on the hot and cold sides are 75° C and 20° C respectively. The exit temperature of hot water is 45^oC . If the individual heat transfer coefficients on both sides are 650 W/ m^2 ^{0}C, calculate the area of the heat exchanger.   12

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TURN OVER

4(a) Explain hydrodynamic and Thermal Boundary Layer   5

  (b) With the help of dimensional analysis method, prove that for convection:-

      Nu=constant x $(Re)^m$ x $(Pr)^n$ 8

  (c) Explain shape factor and its properties. Find the shape factor of a cylindrical cavity of diameter D and depth H w.r.t. itself.   7

5(a) A hot cylinder ingot of 60 mm diameter and 200 mm long is taken out from the furnace at 900^0C and dipped in water till its temperature falls to 500^oC. Then it is directly exposed to air till its temp falls to 100^oC. Find the total time required for the ingot to reach the temperature from 900^oC to 100^oC. Take the following properties K=50 W/m^{o}C, C (specific heat of ingot) =200 J/m^{o}C, ρ (density of ingot) =800 kg/m^3, h_w (heat transfer coefficient in water =200 W/m^2 ^{o}C, h_a (heat transfer coefficient in air) =20 W/m^2 ^{o}C, temperature of air or water as 30^oC.   8

  (b) Write short notes on: 12
      (1) Boiling Curve
      (2) Shape Factor Algebra
      (3) Critical Radius and Thickness of insulation.

6(a) Explain the terms: Effectiveness, NTU, and LMTD   6

  (b) What are Fourier and Biot numbers ? What is the physical significance of these numbers?   8

(c) Distinguish between Specular and diffuse radiation   6

7(a) A distillation column containing a mixture of benzene and toluene is at pressure of 1 bar and temperature of 105^oC . The liquid vapor phase contain 20 mol% of benzene and 55 mol% of toluene respectively. At 105^oC vapor pressure of the toluene is 0.72 bar and its diffusivity is 5.2 x10^{-6} m^2/s. Assuming the equimolar diffusion , calculate the molar diffusion flux of toluene if the diffusion zone is 0.35 m thick. Take universal gas constant as 8.314 kJ/kg mol K.   12

  (b) State and explain Fick's law of diffusion and derive the condition for equimolar diffusion.   08

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(OLD COURSE)

QP Code : **12171**

(2 Hours)

[Total Marks : 50

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

1. Attempt any **five** of the following :—   10
   (a) What is Ecological Sucession?
   (b) Explain the term 'Hot Spots' of biodiversity.
   (c) What are the causes and effects of ozone layer depletion?
   (d) How value education is important for better environment?
   (e) What is ecosystem? What are the components of any ecosystems?
   (f) What causes marine pollution? What are its effect?
   (g) Why there is need for gender equity?

2. (a) What are the reasons of depletion of natural forest resources? What is its impact?   5
   (b) What are endangered species? What steps are taken for conservation of   5
       biodiversity?

3. (a) Which are the important pollutants who cause air pollution? What effects are   5
       produced by them?
   (b) Explain briefly the characteristic features & functions of grassland ecosystem.   5

4. (a) Why solid waste management is essential? Explain different methods of its   5
       management.
   (b) Describe the important features of water pollution prevention act.   5

5. (a) What is population explosion? What is its impact on environment?   5
   (b) What are the reasons and effects of global warming?   5

6. (a) How Information Technology is useful for better human health and environment?   5
   (b) What causes soil pollution? How it affects us?   5

7. (a) What is disaster management? Explain its significance in the event of landslides.   5
   (b) What role an indivisual can play in prevention of pollution?   5