

218

(3hours)

[Total marks: 80]

- N.B. (1) Question No. 1 is compulsory.  
 (2) Answer **any Three** from remaining  
 (3) Figures to the right indicate full marks

1. (a) State Cauchy Reimann equation in polar form. Find p if

$$f(z) = r^2 \cos 2\theta + ir^2 \sin p\theta \text{ is analytic.} \quad 5$$

(b) Find Laplace transform of  $\sin 2t \cdot \cos 3t$ . 5

(c) Prove  $\{\sin nx\}$ ,  $n = 1, 2, 3, \dots$  is orthogonal w.r.t.  $(0, 2\pi)$ . 5

(d) Evaluate  $\int_{1+i}^{2+4i} (x^2 + ixy) dz$  along the curve  $x = t, y = t^2$ . 5

2. (a) Using Laplace transform, solve the differential equation,

$$\frac{dx}{dt} + 3x = 2 + e^{-t}, \text{ with } x(0) = 1. \quad 6$$

(b) Evaluate  $\oint_C \frac{z+1}{z^3 - 2z^2} dz$  where  $C: |z| = 1$ . 6

(c) Obtain the Taylor's and Laurent series which represent the function

$$\frac{z^2 - 1}{(z+3)(z+4)} \text{ in the regions, (i) } |z| < 3 \text{ (ii) } 3 < |z| < 4 \text{ (iii) } |z| > 4. \quad 8$$

3. (a) Solve  $\frac{\partial^2 u}{\partial x^2} - 32 \frac{\partial u}{\partial t} = 0$  by Bender-Schmidt method, given

$$u(0, t) = u(x, 0) = 0, \quad u(1, t) = t, \text{ taking } h = 0.25. \quad 6$$

(b) Evaluate-  $\int_0^\infty t e^{-3t} \sin t dt$  6

(c) Obtain Half Range Sine Series of  $f(x) = x(\pi - x)$  in  $(0, \pi)$ .

$$\text{Hence, evaluate } -\sum_{m=0}^{\infty} \frac{(-1)^m}{(2m+1)^3}. \quad 8$$

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4. (a) Find the orthogonal trajectory of the family of curves  $x^3 y - xy^3 = 0$ . 6

(b) Find Fourier series of  $f(x) = |x|$  in  $(-3, 3)$ . 6

(c) Find the inverse Laplace transform of the following:-

(i)  $\cot^{-1} s$                       (ii)  $\frac{8e^{-3s}}{s^2 + 4}$  8

5. (a) Solve by Crank-Nicholson simplified formula  $\frac{\partial^2 u}{\partial x^2} - \frac{\partial u}{\partial t} = 0$ ,

$$u(0, t) = u(1, t) = 0, \quad u(x, 0) = 100x(1 - x)$$

taking  $h = 0.25$  for one time step. 6

(b) Using convolution theorem find the inverse Laplace transform of

$$\frac{s}{(s^2 + 1)(s^2 + 4)} \quad 6$$

(c) Find bilinear transformation which maps the points  $z = 1, i, -1$  onto the points  $w = i, 0, -1$ . Hence, find the image of  $|z| \leq 1$  onto the  $w$ -plane. 8

6. (a) Using Residue theorem, evaluate,  $\int_0^{\infty} \frac{dx}{x^2 + 1}$ . 6

(b) Obtain Complex form of Fourier series for  $f(x) = e^{ax}$  over  $-\pi < x < \pi$ . 6

(c) Determine the solution of one-dimensional heat equation  $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$  under boundary condition  $u(0, t) = u(l, t) = 0$ ,  $u(x, 0) = x$ ,  $l$  being the length of rod. 8

50

(3 Hours)

Maximum Marks: 80

N.B. i) Question No.1 is compulsory. Attempt any three from remaining questions.

ii) Assume any suitable data if required, state the same clearly.

iii) Figures to the right indicate full marks.

iv) Attempt sub questions in order.

1. Compare the following: (5x4=20)

- (i). Chain Survey and Compass survey.
- (ii). Trapezoidal rule and Prismoidal rule.
- (iii). Surveyor's compass and Prismatic compass.
- (iv). Rise and fall method and Plane of collimation method.

2.a. The following notes refer to the reciprocal levelling:

Instrument Station	Staff readings on		Remarks
	A	B	
A	1.030	1.63	Distance between A and B = 800m R L of A is 440.
B	0.950	1.54	

Find (i) the true R.L. of B, (ii) Combined corrections for curvature and refraction and (iii) Error in collimation adjustment of the instrument. (08)

2.b. Write a detailed note on obstacles in chain surveying. (07)

2.c. A line was measured with steel tape which was exactly 30m at a pull of 5kg and measured length was 229.62m. The pull applied during measurement was 10kg and the tape was uniformly supported. Find the true length of line if the cross-sectional area of tape was 0.02cm<sup>2</sup> and modulus of elasticity of tape material = 2.1x10<sup>6</sup> kg/cm<sup>2</sup>. (05)

3.a. Compare closed traverse and open traverse. (04)

3.b. Compare well-conditioned and ill conditioned triangle. (04)

3.c. What is a local attraction? Which are the methods of elimination of local attraction? (06)

3.d. Describe advantages and disadvantages of plane table survey. (06)

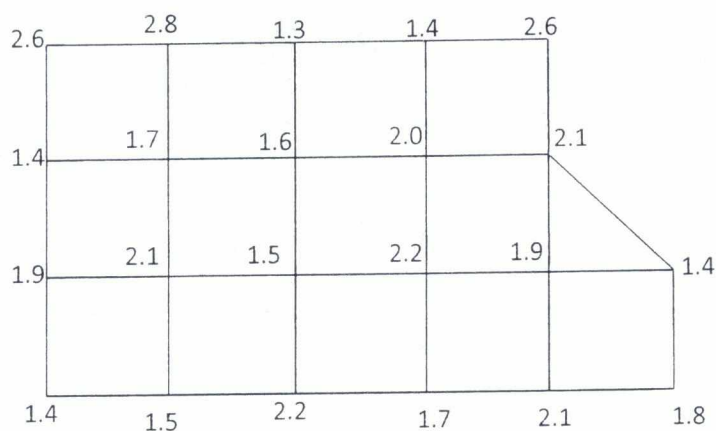
4.a. Calculate the included angles for the **closed** compass traverse ABCDA run clockwise from following data: (10)

Line	AB	BC	CD	DA
F B	40°	70°	210°	280°

4.b. Calculate the missing quantities for a theodolite survey of closed traverse ABCDA: (10)

Line	AB	BC	CD	DA
Length in m	550	1200	880	1050
Azimuth	60°	?	?	310°

5.a. Calculate the volume of earth removed for a piece of borrow pit shown. At the corners, the data mentioned is amount of cut in meters. Each square is 9mx9m. (10)



5.b. Describe in detail procedure of taking bearing of a line with theodolite. (05)

5.c. Explain in detail the use of theodolite as a level (05)

6. a. Define contour. Explain the methods of interpolation of contours. (08)

6.b. Describe the working of Amsler's planimeter. (05)

6.c. Explain how the project of theodolite traversing is executed? (07)

94

(3 Hours)

[Total Marks: 80

- N. B.: 1) Question No. 1 is **Compulsory**.  
 2) Answer any **three** from the remaining.  
 3) Each **full** question carries **equal** marks.  
 4) **Assume** suitable data, if needed & **state** it clearly.

Q. 1 (a) Choose & write the correct option: (02 M)

A solid circular shaft of diameter (d) is subjected to a bending moment (M). The same shaft is then subjected to a pure torque (T), such that  $T = M/2$ . The ratio of Maximum Bending Stress to Maximum Shear Stress is:

- (i) 2 (ii) 4 (iii) 3 (iv) 1.5

(b) Choose & write the correct option: (02 M)

If a simply supported beam of circular cross-section with diameter (D) & length (l) carries a point load (W) at the centre of the beam, then the strength of the beam is proportional to:

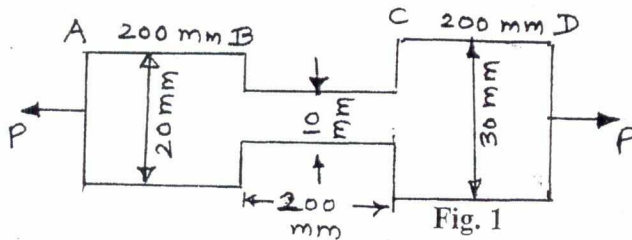
- (i)  $1/D^3$  (ii)  $1/D^2$  (iii)  $D^3$  (iv)  $D^2$

(c) What are the assumptions of Euler's column buckling theory? (04 M)

(d) Locate core (i.e. Kernel) of the solid rectangular section of width 400 mm & depth 600 mm. (04 M)

(e) Choose & write the correct option: (04M)

A mild steel bar is in three parts, each 200 mm long (fig. 1). The diameters of the parts are indicated on the diagram. The bar is subjected to axial pull of (P) N. If  $E = 2 \times 10^5$  MPa & the elongations in the three parts AB, BC & CD are  $\Delta_1$ ,  $\Delta_2$  &  $\Delta_3$  respectively, then the ratio of the greatest elongation to the least elongation will be:



- (i) 9 (ii) 4  
 (iii) 3 (iv) 2

(f) Derive the relationship between the loading (w), Shear Force (F) & Bending Moment (M). (04 M)

Q. 2 (a) The beam (fig. 2) is bolted (pinned or hinged) at A & rests on a bearing pad at B that exerts an upward UDL on the beam over its 0.6 m length. Draw the Shear Force Diagram & Bending Moment Diagram for the beam. Show the SF & BM values at all the important points. (08 M)

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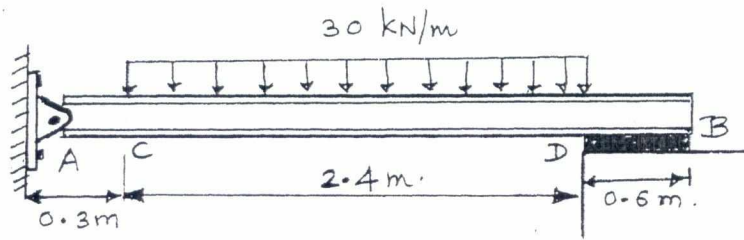


Fig. 2

(b) The engine of a helicopter is delivering 450 kW to the rotor shaft AB when the blades are rotating at 1200 Revolutions/Minute. Determine the diameter of the shaft AB, if the allowable shear stress in shaft AB is 74 MPa & the vibrations limit the angle of twist of shaft AB to 0.05 radians. The shaft is 0.6 m long & modulus of rigidity for the shaft material = 75 GPa. Refer fig. 3. (08 M)

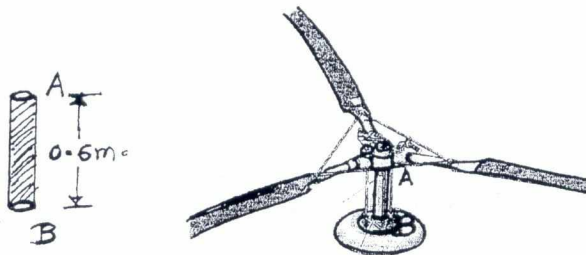


Fig. 3

(c) Write a note on flitched beams, with neat sketches. (04 M)

Q. 3) (a) The beam AB is used in a railroad yard for loading & unloading cars. The hoist travels along the bottom flange of the I section beam AB (fig. 4). Assume the beam AB is pinned to the column at B & roller supported at A. At what position of the hoist load, the Bending Moment in beam AB will be maximum? The C/S details of beam AB are shown. If the allowable bending stress in the beam material is 170 MPa, what will be maximum value of hoist load, that can be allowed to be lifted? Calculate maximum Bending Moment corresponding to maximum hoist load. (08 M)

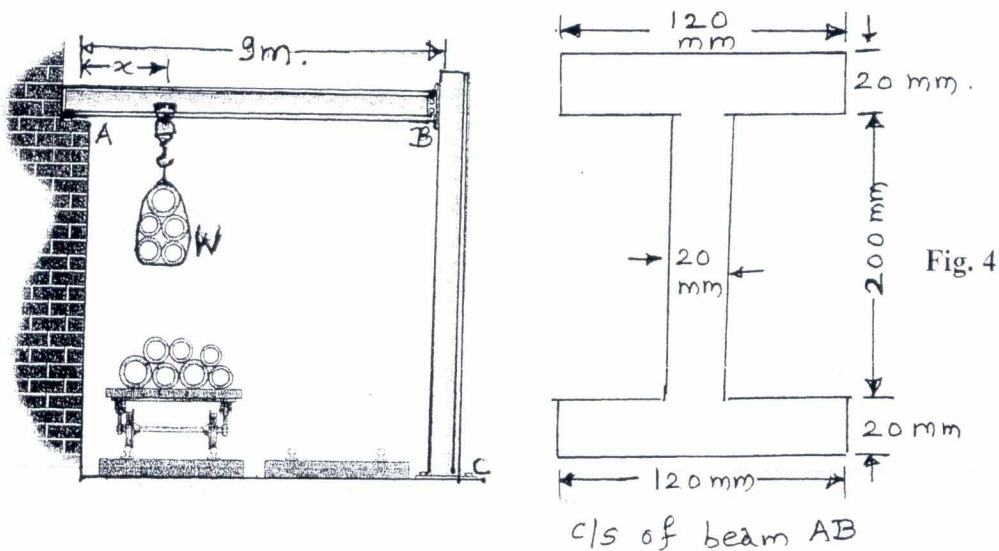


Fig. 4

(c) Consider the following statements in connection with Euler's Column Buckling theory

I. The elastic critical stress in compression increases with decrease in slenderness ratio.

II. The effective length depends on the boundary conditions at the ends of column.

III. The elastic critical stress in compression is independent of the slenderness ratio.

IV. The ratio of effective length to its least radius of gyration is called as slenderness ratio.

The TRUE statements are:

(02 M)

(i) II & III

(ii) III & IV

(iii) II, III & IV

(iv) I, II & IV

(d) What was the shortcoming of the Euler's Column Failure theory? Write Rankine's Column Crippling theory, indicating the meaning of each term. (02 M)

Q. 6 (a) The Principal Stresses at a point across two perpendicular planes are 100 MPa (tensile & horizontal) and 60 MPa (tensile & vertical). Determine the normal, shear & resultant stresses in magnitude & direction in a plane, the normal of which makes an angle of  $30^\circ$  with the direction of maximum principal stress. Use either analytical method or graphical method. (08 M)

(b) A bar of steel is (60 mm X 60 mm) in section & 180 mm long. It is subjected to a tensile load of 320 kN along the longitudinal axis & tensile loads of 760 kN & 600 kN on the lateral faces. Find the change in the dimensions of the bar & the change in volume. Take  $E = 200 \text{ GN/m}^2$  & Poisson's ratio = 0.3. (08 M)

(c) A steel rod 15 m long is at a temperature of  $16^\circ \text{C}$ . Find the free expansion of the rod when the temperature is raised to  $66^\circ \text{C}$ . Find the temperature stress produced, when the expansion of the rod is fully prevented. (04 M)

(b) A 30mm dia. solid circular aluminium rod 3 m long, is subjected to an axial pull of 100kN. Taking  $E = 70 \text{ GN/m}^2$  & Poisson's Ratio =  $(1/3)$ , determine the elongation, change in diameter & change in volume of the rod. Also, find the bulk modulus. (08 M)

(c) Draw typical Shear Stress Distribution diagrams for the symmetrical I section (symmetrical about both the axes), T section, solid rectangular section & circular section. (04 M)

Q. 4) (a) A thin cylindrical shell, 3.25 m long & 1 m internal diameter, is subjected to an internal fluid pressure of 1.2 MPa. The shell thickness is 10 mm. Find the circumferential & longitudinal stresses. Find also the maximum shear stress & change in dimensions. Also, determine the change in volume. Take  $E = 200 \text{ GN/m}^2$  & Poisson's ratio = 0.3. (08 M)

(b) For a solid rectangular section, show that the maximum shear stress =  $(1.5 \times \text{Average shear stress})$ . A symmetrical I section beam has flange width 220 mm, flange thickness = 20 mm, web thickness = 15 mm & web depth = 300 mm. It carries a shear force of 110 kN. Sketch Shear Stress Distribution across the section. (08 M)

(c) Derive an expression for the strain energy due to suddenly applied loads. (04 M)

Q. 5) (a) The following results were obtained in a tension test on a Mild Steel specimen of Gauge Length 50 mm & diameter 14 mm (observations are given only up to yield point). Yield Load = 35.5 kN, Ultimate Load = 58 kN, Breaking Load = 46 kN, Final Gauge Length = 73 mm, Final Gauge Diameter at Neck = 8.4 mm. Determine Young's Modulus, Ultimate Stress, Breaking Stress, Percentage Elongation, Percentage Reduction in Area & True Stress at fracture. (08 M)

Load (kN)	0	1.5	7	10	14	18.5	22	25	28.5	34	35.5
Extension (mm)	0	0.005	0.01	0.015	0.02	0.025	0.03	0.035	0.04	0.045	0.05

(b) A concrete dam has the cross-section shown in fig. 5. Determine the maximum & minimum stresses at the base of the dam (section m-n). The concrete density =  $24 \text{ kN/m}^3$  & Unit weight of water  $\gamma_w = 9.81 \text{ kN/m}^3$ . Consider the length of the dam as 1 m. Draw the Stress Distribution Diagram at the Dam base. (08 M)

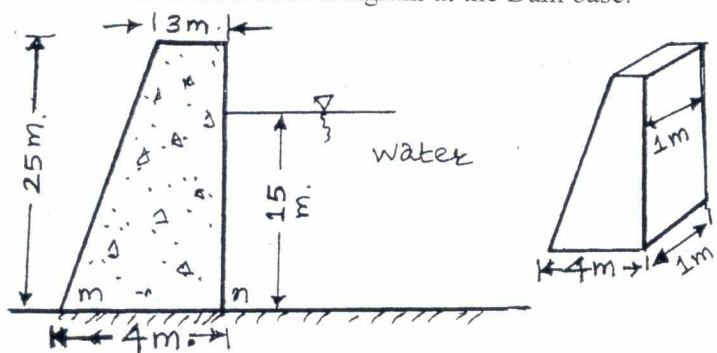


Fig. 5

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CBSGS

80 Marks

3 Hours

N. B. 1. Question no. 1 **compulsory.**

2. Answer any three questions out of remaining
3. Assume any data, if required and state them clearly
4. Attempt sub questions in order
5. Illustrate answer with neat sketches wherever required
6. Figures to the right indicate full marks.

I Write short notes on any five :-

[20]

- a) Load Bearing and Frame Structure
- b) Flooring materials
- c) Pointing
- d) Grade of Cement
- e) Damp Proofing materials
- f) Acid test on stone

2. a) What are the objects of providing foundations to the structure? Explain combine footing with neat sketch. [5]
- b) Explain the anti corrosive treatment provided to metals. Write the use of aluminium in construction industry [7]
- c) Give the detailed sketch of  $1\frac{1}{2}$  wall constructed in English bond and Flemish Bond [8]
3. (a) Mention experiments performed in laboratory on tiles and bricks? Explain any one experiment (either of brick or of tile) in detail. [7]
- (b) Compare paints and varnishes. [5]
- (c) What do you mean by seasoning of timber? Explain methods of seasoning of timber? [8]
4. (a) List out the various types of glasses and state their properties and uses in construction. [8]
- (b) What is form-work? Which materials are used for form-work? State advantages and disadvantages of steel formwork. [4]
- (c) Explain briefly the dry process of manufacturing of cement [8]
5. (a) Sketch the cross-section of Queen-post truss and name the various members in it. [6]
- (b) Explain the field tests to find the quality of any two construction materials. [6]
- (c) Sketch the cross-sections and elevations of: [8]
  - (i) Putlog scaffolding
  - (ii) Un-coursed Random Rubble Masonry.
6. (a) Define ventilation. Explain systems of ventilation [8]
- (b) Write short notes on : [12]
  - (i) Plastering
  - (ii) Sound insulation
  - (iv) Hydraulic Lime

## REVISED COURSE

(3 Hours)

[Total Marks: 80]

- N.B.** 1. Question No. 1 is **compulsory**  
 2. Attempt any **three** questions out of remaining **five** questions.  
 3. Draw neat **labelled diagrams** wherever necessary.  
 4. All the parts of a question should be **grouped together**.  
 5. Figures to the **right** indicate marks

- Q.1a Write the identifying properties and economic use of the following minerals- 5  
 (i) Calcite  
 (ii) Graphite  
 (iii) Biotite  
 (iv) Orthoclase  
 (v) Corundum
- Q.1b Define the following terms- 5  
 (i) Engineering Geology  
 (ii) Exfoliation  
 (iii) Seismograph  
 (iv) Delta  
 (v) Cone of Depression
- Q.1c Draw a neat sketch of the following - 5  
 (i) Pedestal/mushroom rock  
 (ii) Columnar joint  
 (iii) Dyke  
 (iv) Box fold  
 (v) Alluvial Fan
- Q.1d Name the following - 5  
 (i) Boundary between crust and mantle  
 (ii) A texture of rock where all the constituent grains are of equal size  
 (iii) Water present in the pore spaces of rock beneath the earth surface  
 (iv) The type of metamorphism where pressure plays the dominant role  
 (v) The depression at the mouth of volcano
- Q.2(a) Describe various landforms created by glaciers. 10  
 (b) What is chemical weathering? 5  
 (c) Briefly describe internal structure of Earth 5
- Q.3(a) Describe various textures of Igneous rocks. 10  
 (b) How sedimentary rocks are formed, describe any two structures of these rocks. 5  
 (c) Describe various agents of metamorphism 5
- Q.4(a) What are Faults? Give a brief account of various types of Faults in the rocks. 10  
 (b) What is order of superposition? 5  
 (c) What are the various causes of landslide? 5

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- Q.5(a) Describe the seismic method of geophysical investigation 5  
(b) Describe the favourable and unfavourable geological structures while choosing the alignment of tunnel . 10  
(c) Describe the zones of groundwater 5
- Q.6 Differentiate between any 5 of the following- 5X4=20  
(i) Confined and unconfined aquifer  
(ii) Overturned and recumbent fold  
(iii) Angular unconformity and Nonconformity  
(iv) Central eruption and Fissure eruption  
(v) Thermal and Dynamic Metamorphism  
(vi) Strike and streak  
(vii) Fracture and cleavage
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3 Hours

Max Marks: 80

- N.B.
1. Question No. 1 is compulsory
  2. Solve any three question of the remaining questions
  3. Assume suitable data if required
  4. Draw neat figure

Q.1. Attempt any four (20)

- (a) What is the difference between dynamic viscosity and kinematic viscosity? State their Units of measurement.
- (b) Explain the procedure of finding hydrostatic forces on curved surfaces.
- (c) What are the conditions of equilibrium of a floating body and submerged body?
- (d) Sketch the flow pattern of an ideal fluid flow passed past a cylinder with circulation.
- (e) Describe with a help of sketch the construction and use of pitot static cube.
- (f) Explain the classification of orifices and mouth pieces based on their shape, size and Sharpness?

Q.2. (a) A soap bubble 51mm in diameter has an internal pressure in excess of outside pressure of  $0.00021 \text{ Kg(f)/cm}^2$ . Calculate the tension in soap fill. (05)

(b) A U-tube differential manometer connects to pressure pipe A and B. Pipe A contains carbon tetrachloride having specific gravity 1.594 under a pressure of  $1.2 \text{ kg(f)/cm}^2$  and pipe B contains oil of specific gravity 0.8 under a pressure of  $2 \text{ kg(f)/cm}^2$ . Pipe A lies 2.5m above pipe B. Find the difference of pressure measured by mercury as fluid filling U-tube. Mercury level in left limb is 3.75m below pipe A. (10)

(c) Define the fluid properties (i) Density. (ii) Specific volume. Also give its SI Unit. (05)

Q.3. (a) What is the difference between Sluice gate and Lock gate? (04)

(b) A hollow circular plate of 2m external diameter and 1m internal diameter is immersed vertically in water such that the centre of plate is 4m deep from water surface. Find the Total pressure and depth of centre of pressure. (10)

(c) A rectangular Pontoon is 4m long, 3m wide and 1.4m high in sea water. If the Centre of gravity is 0.7m above the Pontoon, determine the meta centric height. Take the density of sea water as  $1030 \text{ Kg/m}^3$ . (06)

Q.4. (a) The velocity components in two dimensional flow field for an in-compressible fluid are expressed as  $u = (y^3/3) + 2x - (x^2y)$ ,  $v = xy^2 - 2y - (x^3/3)$  (10)

(i) Show that these functions represent a possible case of an ir-rotational flow.

(ii) Obtain an expression for stream function  $\psi$ .

(iii) Obtain an expression for velocity potential  $\phi$ .

(b) Define the equation of continuity. Obtain an expression for continuity equation for a three dimensional flow. (10)

Q.5. (a) Explain the principle of venturimeter with a neat sketch. Derive the expression for the rate of flow of fluid through it. (10)

(b) A pipe line carrying oil of specific gravity 0.87 changes in diameter from 300mm diameter at a position A to 600mm diameter at a position B which is 4m at a higher level. If the pressure at A and B are  $9.81 \text{ N/cm}^2$  and  $5.886 \text{ N/cm}^2$  respectively and the discharge is 200 lit/s. Determine the loss of head and direction of flow. (10)

Q.6. (a) What do you understand by velocity of approach? Find an expression for the discharge over a rectangular weir with velocity approach. (10)

(b) A broad crested weir of 50m length has 50cm height of water above its crest

(i) Find the maximum discharge. Take  $C_d = 0.60$ . Neglect velocity of approach.

(ii) If the velocity of approach is to be taken into consideration. Find the maximum discharge when the channel has a cross sectional area of  $50\text{m}^2$  on the upstream side. (06)

(c) What is the difference between a notch and weir? (04)