1(a) A vector field is given by $\vec{F} = (x^2 + xy^2)i + (y^2 + x^2y)j$. Show that the field is irrotational, and find the scalar potential function.

(b) Find the directional derivative of $x^2 + y^2 + 4xyz$ at $(1, -2, 2)$ in the direction $(2i - 2j + k)$.

OR

(b') Show that $\text{div}(\text{grad } r^n) = n(n + 1)r^{n-2}$, hence evaluate $\nabla^2 \left( \frac{1}{r} \right)$

(\text{where } \vec{r} = x\hat{i} + y\hat{j} + z\hat{k}, r = |\vec{r}| = \sqrt{x^2 + y^2 + z^2}).$\hspace{1cm} (7.5, 7.5)$

2.(a) Use divergence theorem to evaluate the surface integral $\iint_S \vec{F} \cdot \vec{N} \, ds$, where $\vec{F} = x^3\hat{i} + x^2y\hat{j} + x^2z\hat{k}$ and $S$ is the surface of the cylinder $x^2 + y^2 = a^2, z = 0, z = b$.

(b) Verify Green's theorem in a plane

$\int_C [(2x^2 - y^2)dx + (x^2 + y^2)dy]$, where $C$ is the boundary of the surface in the $XY$-Plane enclosed by the x-axis and the semi-circle $y = \sqrt{1 - x^2}$.
3. (a) Find the polar form of Cauchy–Riemann equation and use it to show that 

\[ \log z \] is analytic.

OR

(a') If \( f(z) \) is an analytic function of \( z \), prove that

\[ \left( \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} \right) |f(z)|^2 = 4 |f'(z)|^2. \]

(b) Use Cauchy's integral formula to evaluate \( \int \frac{\cos \pi z^2}{(z-1)(z-2)} \, dz \), where \( c \) is a circle (i) \( |z| = \frac{3}{2} \) (ii) \( |z| = 3 \)

4. (a) Form the partial differential equations by eliminating the arbitrary constants and arbitrary function from the following relations:

(i) \( ax^2 + by^2 + z^2 = 1 \)

(ii) \( z = f\left(\frac{xy}{z}\right) \).

(b) A tightly stretched string with fixed end points \( x = 0 \) and \( x = l \) is initially in a position given by \( y(x, 0) = y_0 \sin\left(\frac{nx}{l}\right) \). If it released from rest from this position, find the displacement \( y \) at any distance \( x \) from one end at any time \( t \).

OR

(b') Show that the solution of the differential equation \( \frac{\partial u}{\partial t} = k \frac{\partial^2 u}{\partial x^2} \), subject to the condition

(i) \( u \) not infinite for \( t \to \infty \), (ii) \( \frac{\partial u}{\partial x} = 0 \) for \( x = 0 \) and \( x = l \),

(iii) \( u = lx - x^2 \) for \( t = 0 \), between \( x = 0 \) and \( x = l \), is

\[ u = \frac{t^2}{l^2} - \frac{t^2}{\pi^2} \sum_{n=1}^{\infty} \frac{1}{n^2} e^{-\frac{(4n^2\pi^2kt)}{l^2}} \cos\left(\frac{2\pi nx}{l}\right). \]
1(a) A field is generated by certain distribution of charge given by
\[ \vec{F} = (x + 2y + az)i + (bx - 3y - z)j + (4x + cy + 2z)k. \]
Find the values of \( a, b, c \) so that \( \vec{F} \) is irrotational. Hence find the scalar potential function.

(b) Find the directional derivative of \( P = 4e^{2x-y+z} \) at the point \((1,1,-1)\) in a direction:
   (i) towards the point \((-3, 5, 6)\)
   (ii) parallel to the line \( \frac{x}{1} = \frac{y}{2} = \frac{z}{3} \).

(b') Show that the \( \text{div}(r^m \vec{r}) = (n + 3)r^{n-1}, \) where \( r = |\vec{r}| \) and
\[ \vec{r} = xi + yj + zk. \]

2.(a) Use divergence theorem to evaluate the surface integral \( \iint_S \vec{F} \cdot d\vec{S} \), where
\[ \vec{F} = x^3i + y^3j + z^3k \] and \( S \) is the surface of the sphere \( x^2 + y^2 + z^2 = 1 \).

(b) Verify Green's theorem in a plane to evaluate
\[ \int_C [(2x^2 - y^3)dx + (x^2 + y^2)dy], \] where \( C \) is the boundary of the surface in \( xy \)-plane between \( x^2 = y \) and \( y^2 = x \).
Verify Stoke’s theorem for the function \( F = x^2\hat{i} + xy\hat{j} \) integrated round the square in the plane \( z = 0 \) and bounded by the lines \( x = 0, \ y = 0, \ x = a \), \( y = a \).

\[ (7, 8) \]

3.(a) Verify that the function \( f(z) = \begin{cases} \frac{x^3y(y-ix)}{x^6+y^2}, & z \neq 0 \\ 0, & z = 0 \end{cases} \) is analytic at \( z = 0 \).

OR

\[ (a') \] If \( f(z) = u + iv \) is an analytic function of \( z \) and \( u + iv = \frac{2\sin 2x}{e^{2y}+e^{-2y}-2\cos 2x} \), find \( f(z) \) in terms of \( z \).

(b) Use Cauchy’s integral formula to evaluate \( \int_C \frac{\cos rz^2}{(z-1)(z-2)} \, dz \), where \( c \) is a circle \( |z| = 3 \).

\[ (b) \]

\[ (8, 7) \]

4.(a) Form the partial differential equations by eliminating the arbitrary constants and arbitrary function from the following relations:

(i) \( (x - h)^2 + (y - k)^2 + z^2 = c^2 \)

(ii) \( f(x^2 + y^2, z - xy) = 0 \)

(b) A tightly stretched string with fixed end points \( x = 0 \) and \( x = l \) is initially in a position given by \( y(x, 0) = y_0 \sin \left( \frac{\pi x}{l} \right) \). If it is released from rest from this position, find the displacement \( y \) at any distance \( x \) from one end at any time \( t \).

\[ \text{OR} \]

(b') A rod of length \( L \) has its ends A and B kept at \( 0^\circ C \) and \( 100^\circ C \), respectively, until steady state conditions prevail. If the temperature of B is then reduced suddenly to \( 0^\circ C \) and kept so, while that of A is maintained, find the temperature \( u(x, t) \) at distance \( x \) from A at time \( t \).

\[ (6, 9) \]
2016-17
B.E. CIVIL II YEAR
(AUTUMN SEMESTER) EXAMINATION
CIVIL ENGINEERING
FLUID MECHANICS (ECE-213)

Maximum Marks: 60
Credits: 04
Duration: Two Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>What is Newton's law of viscosity? A rectangular block with size 0.8m x 0.6m slides down with terminal velocity 1m/s on a fixed bed which is inclined at 30° with horizontal. The gap between block and the bed is 2 mm and is filled by a viscous fluid with viscosity 0.6 N·sec/m². Find the weight of the plate.</td>
<td>06</td>
</tr>
<tr>
<td>1(b)</td>
<td>The velocity vector is defined as ( V = x^2y^2z^2i - x^2y^2z^2j ), find rotation component along X-direction at point P (1,1,1)</td>
<td>03</td>
</tr>
<tr>
<td>1(c)</td>
<td>Given velocity potential ( \phi = xy^2 + 2xy ), find stream function ( \psi ).</td>
<td>06</td>
</tr>
</tbody>
</table>

OR

Q1'(a) Differentiate among:
(i) Circulation and Vorticity
(ii) Velocity Potential and Stream Function
(iii) Path line and streak line

1'(b) A water droplet of radius \( R \) breaks into \( n \) numbers of smaller droplets. The work done in this process is \( W = 12\pi R^2 \). Find the value of \( n \).

1'(c) Show that equi-potential lines and stream lines always intersect at right angles.

2(a) What is hydro-static law? Explain the working of a U-tube manometer fitted in a horizontal pipe line taking suitable notations.

(b) What are significances of total pressure and centre of pressure? An equilateral triangular plate of side 1.2 m is vertically immersed in water in such a manner that its base is parallel to free surface and its vertex lies on the free surface. Find hydrostatic force on the plate.

OR

Contd...
2'(a) Explain the type of equilibrium of a floating body. Give few examples of each type.

2'(b) A cylindrical gate (length = 12 m and diameter = 2.0 m) is kept horizontal on the ground. The gate is fully filled with water up to the top at u/s side and half filled from d/s side. Find the resultant thrust of water on the gate.

Q3(a) List out various assumptions made in the derivation of Bernoulli's Equation. Water enters into a penstock (diameter = 25 cm, length = 50 m) at a rate of 200 l/s as shown in Fig.1. If the pressures at points A and B are 147.15 kN/m² and -34.58 kN/m² respectively, find the power developed by the turbine. The diameter of draft tube at point B is 60 cm.

OR

3'(a) If water is flowing through the bend and if there is no energy loss in the bend, determine the resultant force required to hold the bend in place.

3(b) What are the practical utilities of momentum and torque equations?

A water sprinkler shown in Fig.3 consists of 1 cm jets at either ends of rotating arms. What torque must be applied to hold it stationary when velocity of jet is 6 m/s?

4(a) Explain the terms coefficient of discharge, coefficient of velocity and coefficient of contraction for a sharp crested orifice meter.

(b) Develop the discharge equation for a V-shaped notch taking suitable notations.

(c) How mouthpieces are classified? What are the advantages of Borda’s mouth piece over other types of mouth pieces?
Fig. 1

$D_2 = 10\text{cm}$

Fig. 2

$D_1 = 15\text{cm}$
$V_1 = 6\text{ m/s}$
$P_1 = 205.94\text{ kN/m}^2$ (gauge)
$6\text{ m/s}$

Fig. 3

6 m/s
B. E. (AUTUMN), IIIrd SEMESTER EXAMINATION 2016 – 17
(CIVIL ENGINEERING)
ENGINEERING GEOLOGY (ECE – 215)

MAXIMUM MARKS: 60
Duration: Two Hours

Note: Answer all questions. The marks are given in parenthesis.

1. Give a short account of internal structure of the earth and its operation within the purview of plate tectonics. (15)

OR

1'a. Enumerate different types of metamorphism and resultant rocks with their characteristics. (7.5)

1'b. What are the causes of volcanism? List different volcanic rocks with their characteristics. (7.5)

2a. What are joints? Give their classification scheme and significance in civil engineering. (7.5)

2b. Enumerate different exogenous processes and important civil engineering issues related to them. (7.5)

3. Write short notes on any two of the following:
   a. Stratigraphy and its fundamental concepts (7.5)
   b. Groundwater in consolidated medium (7.5)
   c. Core Recovery Percent and Rock Quality Designation (7.5)

4. Enumerate different uses of rocks in civil engineering and important physico-mechanical properties to be ensured. (15)

OR

4’. List different causes of land sliding. Briefly explain passive and active methods of landslide mitigation. (15)
2016-17
B.E. III SEMESTER) EXAMINATION
(CIVIL)
QUANTITY SURVEY
(ECE – 220)

Maximum Marks: 60 Credits: 04 Duration: Two Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question M.M.
1 (a) Write down a short note on estimate emphasizing its importance in civil engineering [07]
   (b) Briefly explain any two types of the following estimates [08]
        (i) Plinth Area Estimate
        (ii) Cube Rate Estimate
        (iii) Approximate Estimate

2 With the help of neat sketch show the various components of a building [15]

OR

2’ Define different parts of a stair case with the help of neat sketch [15]
3(a) Briefly explain the term Analysis of Rate mentioning the factors affecting it. [07]
3(b) Determine the quantity of materials for 25 cubic metre of Reinforced Cement Concrete in beams and slabs in the ratio of 1:1½:3. . [08]

OR

3’ Write short notes on the following [15]
   (i) Capital Cost of Project (ii) Earnest Money and Security Deposit
   (iii) Administrative Approval

4 What is a contract? Discuss in brief the essential requirements of contract. [15]
2016-17
B.E. (AUTUMN SEMESTER) EXAMINATION
CIVIL ENGINEERING
CIVIL ENGINEERING MATERIALS & CONSTRUCTION PRACTICE
ECE-221

Maximum Marks: 60
Credits: 04
Duration: Two Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.  Question                                                      M.M.  [06]
1(a)   With the help of flow chart, describe the manufacture of ordinary Portland cement by dry process. What are the advantages of dry process over wet process?

1(b)   Describe any three of the following:
       (i) Elasticity and creep of concrete
       (ii) Crushing value test of aggregates
       (iii) Compaction factor test of concrete
       (iv) Fineness test of cement
       (v) Properties of hydrophobic cement

2(a)   Describe in detail the classification of different types of timber.

OR

2'(a)  What do you mean by preservation of timber? Write down the characteristics of good preservative and also describe ASCU treatment of preservation of timber.

2(b)   Enumerate various tests conducted on bricks and explain any one of the following:
       (i) Compressive strength test
       (ii) Water absorption test

3(a)   What are building bye-laws and its objectives? Write down the important principles of site selection.

OR

3'(a)  Explain five important points for good orientation of a building. Describe the causes of dampness and list the materials that can be used for damp proofing.
3(b) Describe any four of the following:
(i) Ledged & braced door
(ii) Louvered door
(iii) Bay window
(iv) Pivoted window
(v) Termite proofing in buildings
(vi) Fire fighting in buildings

4(a) What is the need of scaffolding? List different types of scaffolding and explain any one with the help of neat diagram.

4(b) What are the various types of pile hammers? Explain in detail working principle of drop hammer. Describe its advantages and disadvantages.