B. E. (EVENING) (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
HIGHER MATHEMATICS
EAM-231

Maximum Marks: 60
Credits: 04
Duration: Two Hours

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

Q.No.          Question                                                                                              M.M.
1(a)           Find the Laplace transform of the following functions.                                                [08]
                   \begin{align*}
                 (i) & \quad t e^{-t} \sin 3t \\
                 (ii) & \quad \frac{\cos at - \cos bt}{t}
                   \end{align*}

OR

1(a')           Find the inverse Laplace transform of                                                              [08]
                   \begin{align*}
                 (i) & \quad \frac{4s+5}{(s-1)^2(s+2)} \\
                 (ii) & \quad \frac{s+2}{s^2-4s+13}
                   \end{align*}

1(b)           Using Laplace transform, solve the initial value problem                                            [07]
\[ y'' - 3y' + 2y = 1 - e^{2t}, \quad y(0) = 1, \quad y'(0) = 0. \]

2(a)           Find the directional derivative of the surface \( \varphi(x, y, z) = x^2yz + 4xz^2 \) at           [07]
\( (1, -2, 1) \) in the direction of \( 2\hat{i} - \hat{j} - 2\hat{k}. \)

OR

2(a')           Define solenoidal and irrotational vector fields. If \( \vec{F} = (x + y + 1)\hat{i} + \hat{j} - \)  [07]
\( (x + y)\hat{k}, \) show that \( \vec{F}. \text{curl} \vec{F} = 0. \)

2(b)           Show that the vector field \( \vec{v} \) is irrotational where \( \vec{v} = (y^2 - x^2 + y)\hat{i} + \)  [08]
\( x(2y + 1)\hat{j} \) and find a scalar function \( f \) such that \( \vec{v} = \text{grad} f. \)

3(a)           A vector field is given by \( \vec{F} = \sin y \hat{i} + x(1 + \cos y)\hat{j}. \) Evaluate the line integral  [07]
over a circular path \( x^2 + y^2 = a^2, \quad z = 0. \)

Contd... 2.
3(b) Apply Green's theorem to evaluate \( \int_C (2x^2 - y^2) \, dx + (x^2 + y^2) \, dy \), where \( C \) is the boundary of the area enclosed by the x-axis and the upper half of the circle \( x^2 + y^2 = a^2 \).

OR

3(b') Use divergence theorem to evaluate \( \iiint_S \vec{F} \cdot \vec{n} \, ds \), where \( \vec{F} = yz \hat{i} + zx \hat{j} + xy \hat{k} \) and \( S \) is the surface of sphere \( x^2 + y^2 + z^2 = 1 \) in the first octant.

4(a) Find the analytic function \( f(z) = u + iv \) of which the real part is

\[
u = e^{2x}(x \cos 2y - y \sin 2y).
\]

OR

4(a') If \( \varphi \) and \( \psi \) are functions satisfying Laplace's equation and if \( s = \frac{\partial \varphi}{\partial y} - \frac{\partial \psi}{\partial x} \) and \( t = \frac{\partial \psi}{\partial x} + \frac{\partial \varphi}{\partial y} \), show that \( s + it \) is analytic.

4(b) Evaluate by using Cauchy's integral formula

(i) \( I = \oint_C \frac{e^{-z}}{z^2} \, dz \), where \( C \) is the circle \( |z| = 2 \),

(ii) \( I = \oint_C \frac{z^2 + 1}{z(2z - 1)} \, dz \), where \( C \) is the circle \( |z| = 1 \).
2018-19
B. E. (EVENING) (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
HIGHER MATHEMATICS
EAMS-2310

Maximum Marks: 60 Credits: 04 Duration: Two Hours

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

Q.No. Question M.M.
1(a) Show that the polar form of C-R equations is
\[
\frac{\partial u}{\partial r} = \frac{1}{r} \frac{\partial v}{\partial \theta}, \quad \frac{\partial v}{\partial r} = -\frac{1}{r} \frac{\partial u}{\partial \theta}.
\]
Use the result to find \( p \) such that the function
\[ f(z) = r^2 \cos 2\theta + ir^2 \sin \theta \] is analytic.

1(b) Define analytic function. If \( f(z) = u + iv \) and \( u - v = (x - y)(x^2 + 4xy + y^2) \), find analytic function \( f(z) \) in terms of \( z \).

OR

1(b') Using Cauchy’s integral formula, evaluate

(i) \[ I = \oint_C \frac{e^{-z}}{(z-1)(z-2)^2} \, dz \] where \( C \) is the circle \(|z| = 3\),

(ii) \[ I = \oint_C \frac{z^2 - z - 1}{z(z-1)^2} \, dz, \quad |z - 1| = 1. \]

2(a) Expand the function \( f(z) = \frac{z^2 - 1}{(z+2)(z+3)} \) in Laurent’s series about \( z = 0 \) in the regions

(i) \(|z| < 2\)  \( \) (ii) \( 2 < |z| < 3. \)

2(b) Find the residues of \( f(z) = \frac{z^3}{(z-1)^4(z-2)(z-3)} \) at its poles and hence evaluate
\[ \oint_C f(z) \, dz \] where \( C: |z| = \frac{5}{2} \).

OR

2(b') Using method of residues, prove that
\[ \int_0^{2\pi} \frac{\cos 3\theta}{5 - 4\cos \theta} \, d\theta = \frac{\pi}{12}. \]

Contd... 2.
3(a) Find the directional derivative of \( f(x, y, z) = x^2y^4 + z^2y^4 + x^2z^4 \) at the point (2,0,3) in the direction of outward normal to the sphere \( x^2 + y^2 + z^2 = 14 \) at the point (3,2,1).

OR

3(a') Show that \( \text{div}(\text{grad} \; r^n) = n(n+1)r^{n-2} \) where \( r = |\vec{r}| \).

3(b) Show that the vector field given by \( \vec{F} = (2xy + z^2)i + (2yz + x^2)j + (2xz + y^2)k \) is irrotational. Find a scalar function \( \varphi \) such that \( \vec{F} = \text{grad} \; \varphi \).

4(a) Find the work done in moving a particle once round the circle \( x^2 + y^2 = 9 \) in the \( XY \) plane if the force field is given by \( \vec{F} = (2x - y - z)i + (x + y - z^2)j + (3x - 2y + 4z)k \).

4(b) Apply divergence theorem to evaluate \( \iiint_S \vec{F} \cdot \hat{n} \; ds \), where \( \vec{F} = x^3i + x^2yj + x^2zk \) and \( S \) is the surface of cylinder \( x^2 + y^2 = 4 \) bounded by \( z = 0, z = 3 \).

OR

4(b') Find the value of \( \iint_S \text{curl} \; \vec{F} \cdot \hat{n} \; ds \) where \( \vec{F} = (x + y)i + (2x - z)j + (y + 4z)k \) using Stoke's theorem for the surface of a triangular lamina with vertices (2,0,0), (0,3,0) and (0,0,6).
1(a) What are the possible methods of preventing impurities and turbulence in casting? Define gating ratio and differentiate between pressurize and non-pressurize gating systems.

1(b) A cylindrical casting is 0.3 m in diameter and 0.5 m in length. Another casting of the same metal as the cylindrical casting is a cuboid of 0.3 m × 0.3 m × 0.5 m. Both pieces are casted under the same conditions. Compute the difference in the solidification times of the two castings.

OR

1'(a) How the solidification of pure metal is different from the solidification of alloys, explain clearly with the help of cooling curves.

1'(b) With the help of a neat sketch explain the shell moulding process and give its advantages and disadvantages.

2(a) Explain the following in brief:
   i. Swaging
   ii. Roll forging
   iii. Orbital forging

2(b) What do you understand by draft and no-slip point in flat strip rolling? Also discuss the different types of rolling mills.

3(a) Compare gas tungsten arc welding (GTAW) and submerged arc welding (SAW) processes.

3(b) Two flat copper sheets of 1.2 mm thickness each are spot welded. The process parameters are: current = 5000 A, current flow time = 0.20 s and diameter of electrode = 6 mm. Estimate the heat generated and its distribution in the welding zone. Assume:
   Effective resistance = 144 μΩ
   Density of copper = 8.96 g/cm³
   Heat required to melt 1 g of copper = 800 J
3'(a) Explain the difference between following:
   i. Thermit welding and Friction Welding
   ii. Butt welding and flash butt welding.

3'(b) Consider a Copper joint made up of 2 mm thick Copper plates which are butt welded through resistance heating and then forged together such that the metal up to 1.25mm thick may be flushed out from each plate to make a complete joint. The various process parameters are as follows:
   Current = 110A, Voltage = 15V, Current flow time = 2.5 secs.
   Compute the following:
   i. Energy generated in the process;
   ii. Energy required and its distribution;
   iii. Welding speed.
   Assume the efficiency of the process as 75%, specific energy of Copper 6.1J/mm$^3$ and length of the weldment/weld bead = 5cm

4(a) Differentiate between:
   (i) Atomization and Chemical reduction
   (ii) Jiggering and Isostatic pressing

4(b) Explain the operating principle of electric-chemical machining (ECM). Give its advantages and limitations.

OR

4'. Answer the following:
   i. What is the role of lubricants and binders in PM process?
   ii. What is slip casting?
   iii. Explain the function of dielectric fluid in EDM. Name common dielectric fluids used in EDM.

5 Write detail notes on the following:
   i. Extrusion moulding
   ii. Blow Moulding
   iii. Thermoforming
2018-19
B.E. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
EXPERIMENTAL METHODS AND ANALYSES
EME-220/EMEA-2420

Maximum Marks: 60 Credits: 04 Duration: Two Hours

Answer all the questions.
Assume suitable data if missing.
Use of statistical tables is allowed.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a) The probabilities of poor print quality given no printer problem, misaligned paper, high ink viscosity, or printer-head debris are 0, 0.3, 0.4, and 0.6, respectively. The probabilities of no printer problem, misaligned paper, high ink viscosity, or printer-head debris are 0.8, 0.02, 0.08, and 0.1, respectively. (i) What is the probability of poor print quality? (ii) Determine the probability of high ink viscosity given poor print quality.</td>
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<td></td>
<td>b) The following distribution is given</td>
<td>[5.0]</td>
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<tr>
<td></td>
<td>[ f(x) = \frac{2x+1}{25}, \quad x = 0, 1, 2, 3, 4 ]</td>
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</tr>
<tr>
<td></td>
<td>Calculate:</td>
<td></td>
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<tr>
<td></td>
<td>(i) ( P(X = 4) ) (ii) ( P(X \leq 1) ) (iii) ( P(2 \leq X &lt; 4) ) (iv) ( P(X &gt; -1) )</td>
<td></td>
</tr>
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<td></td>
<td>c) A multiple-choice test contains 25 questions, each with four answers. Assume that a student just guesses on each question. (i) What is the probability that the student answers more than 12 questions correctly? (ii) What is the probability that the student answers fewer than 5 questions correctly?</td>
<td>[5.0]</td>
</tr>
<tr>
<td>1'</td>
<td>d) Show that the following function satisfies the properties of a joint probability mass function.</td>
<td>[5.0]</td>
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<td></td>
<td>[ f_{XY}(x,y) ]</td>
<td></td>
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</tbody>
</table>
|       | \begin{tabular}{|c|c|c|}
| \hline
| \( x \) & \( y \) & \( f_{XY}(x,y) \) \\
| \hline
| 1.0 & 1 & 1/4 \\
| 1.5 & 2 & 1/8 \\
| 1.5 & 3 & 1/4 \\
| 2.5 & 4 & 1/4 \\
| 3.0 & 5 & 1/8 \\
| \hline
| \end{tabular}                                                                                                                                                                                         |       |

cont...
Determine the following:
(i) \( \mu \),  (ii) \( P(X = 2,5/Y = 3) \), (iii) \( P(X < 2.5) \)

b) The following distribution is given
\[
f(x) = \frac{2x + 1}{25}, \quad x = 0, 1, 2, 3, 4
\]
Calculate:
(i) \( P(X = 2) \)  (ii) \( P(X \leq 2) \)
(iii) \( P(2 \leq X < 4) \)  (iv) \( P(X > -2) \)

c) The manufacturing of semiconductor chips produces 2% defective chips. Assume that the chips are independent and that a lot contains 1000 chips. Approximate the following probabilities:
(i) More than 25 chips are defective.
(ii) Between 20 and 30 chips are defective.

| 2 | a) Find the following:
|   | (i) \( \chi^2_{0.025} \) when \( v = 15 \):
|   | (ii) \( P(-t_{0.05} < t < t_{0.01}) \) for \( v = 20 \).
|   | (iii) \( f_{0.01} \) with \( v1 = 24 \) and \( v2 = 19 \);
|   | b) The impurity level (in ppm) is routinely measured in an intermediate chemical product. The following data were observed in a recent test:
|   | 2.4, 2.5, 1.7, 1.6, 1.9, 2.6, 1.3, 1.9, 2.0, 2.5, 2.6, 2.3, 2.0, 1.8, 1.3, 1.7, 2.0, 1.9, 2.3, 1.9
|   | Can you claim that the median impurity level is less than 2.5 ppm? State and test the appropriate hypothesis \( H_0 : \mu = 2.5 \) versus \( H_1 : \mu < 2.5 \) using the sign test with \( \alpha = 0.05 \). What is the \( p \)-value for this test? |

| 3(a) | What do you understand by the “Standards of Measurement”? List different standards of measurement and briefly describe them. |
| 3(b) | What are the desirable characteristics of a transducer element that should be borne in mind while selecting a transducer for a particular application? |
| 3(c) | Formulate the system equation relating the output and input signals for a U-tube manometer. |

OR

| 3(c') | A temperature measuring system, with a time constant of 25, is used to measure temperature of a heating medium, which changes sinusoidally between 350 and 300° with a periodic time of 20 s. Find the maximum and minimum values if temperature, |
as indicated by the measuring system and the time lag between the output and the input signals.

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<tr>
<td>4(a)</td>
<td>Explain the principle of operation of a piezoelectric transducer. Also develop a relation between the applied force ‘( P )' and the distortion ‘( x )’. [04]</td>
</tr>
<tr>
<td>OR</td>
<td></td>
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<tr>
<td>4(a')</td>
<td>What is the fundamental difference in the phenomenon on which a photo-conductive and a photo-emissive transducers work? [04]</td>
</tr>
</tbody>
</table>
| 4(b) | Write short notes on any two:  
   (i) Hydraulic amplifying element  
   (ii) Linear Variable Differential Transformer  
   (iii) High and low band frequency filters  
   (iv) Cathode Ray Oscilloscope [06] |
| 4(c) | List various low pressure measurement techniques and describe any one of them. [05] |
2018-19
B.E. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
Mechanics of Solids (EMEC2110/EME213)

Maximum Marks: 60
Credits: 04
Duration: Two Hours

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

Q.No. Question M.M.
1 (a) At a point in a stressed material the Cartesian stress components are:
\[
\begin{bmatrix}
-40 & 72 & 32 \\
72 & 80 & 46 \\
32 & 46 & 120 \\
\end{bmatrix}
\text{MPa}
\]
Calculate the normal, shear and resultant stresses on a plane whose normal makes an angle of 45° with the X axis and 60° with the Y axis.

(08)

1 (b) The displacements in micro units along x, y and z directions for a solid is given by
\[
u_x = x^2 + yz, \quad u_y = 3 + y + z, \quad u_z = x^2 + y + z
\]
Calculate at \((3, 2, 0)\)
   i) Strain matrix.
   ii) Strain in the direction \(n_x = n_y = n_z = 1/\sqrt{3}\).
   iii) Principal strains.

(07)

OR

1’ (a) Explain the following:
   (i) State of stress at a point.
   (ii) Plane stress and plane strain conditions.
   (iii) Generalized Hook’s law.
   (iv) Octahedral normal and octahedral shear strains.

(04)

1’ (b) The strains determined using the strain rosette shown in
   Fig. 1 during the test of a machine is given by
\[
\varepsilon_1 = -93.1\mu, \quad \varepsilon_2 = 385\mu, \quad \varepsilon_3 = 210\mu
\]
Determine
   (i) the orientation and magnitude of the principal strains in the plane of the rosette,
   (ii) the maximum in-plane shearing strain.

(06)

Fig. 1
1' (c) A rubber cube is inserted in a cavity of the same form and size in a steel block and the top of the cube is pressed by a steel block with a pressure of \( p \) \( \text{ Pascal} \) (Fig 2). Considering the steel to be absolutely hard and assuming that there is no friction between steel and rubber, find

(i) the pressure of rubber against the box walls, and
(ii) the extremum shear stresses in rubber.

![Fig. 2](image)

2 (a) An aluminium column of length \( L \) and rectangular cross section has a fixed end B and supports a centric load at A. Two smooth and rounded fixed plates restrain end A from moving in one of the vertical planes of symmetry of the column, but allow it to move in the other plane (Fig 3).

(a) Determine the ratio \( a/b \) of the two sides of the cross section corresponding to the most efficient design against buckling.

(b) Design the most efficient cross section for the column, knowing that \( L = 500 \text{ mm} \), \( E = 70 \text{ GPa} \), \( P = 20 \text{ kN} \), and that a factor of safety of 2.5 is required.

![Fig. 3](image)

2 (b) A uniform rod of flexural rigidity \( EI \) is bent and loaded as shown in Fig 4. Determine

(i) the horizontal deflection of point D,
(ii) the slope at point D.

![Fig. 4](image)

3 (a) Derive the expressions for the hoop and longitudinal stresses developed in a thick cylindrical pressure vessel subjected to an internal pressure only.
3 (b) A thick cylinder of 100 mm external diameter and 50 mm internal diameter is wound with steel wire of 1 mm diameter, initially stressed to 20 N/mm² until the outside diameter is 120 mm. Determine the maximum hoop stress set up in the cylinder if an internal pressure of 30 N/mm² is now applied.

3 (b') An external pressure of 10 N/mm² is applied to a thick cylinder of internal diameter 160 mm and external diameter 320 mm. If the maximum hoop stress permitted on the inside wall of the cylinder is limited to 30 N/mm², what maximum internal pressure can be applied assuming the cylinder has closed ends? What will be the change in outside diameter when this pressure is applied? \( E = 207 \text{ GPa}, \nu = 0.3 \).

4(a) For the beam shown in Fig. 5, find the reactions at A and C. Also draw the shear force and bending moment diagram. Take flexural rigidity \( EI \) as constant.

![Fig. 5](image)

4(b) Derive Clapeyron's three-moment equation for continuous beams and show that for uniformly distributed load and same level of supports

\[
M_a l_1 + 2M_b (l_1 + l_2) + M_c l_2 = - \frac{w_1 l_1^3}{4} - \frac{w_2 l_2^3}{4}
\]

OR

4(b') The beam shown in Fig. 6 is of length \( l \) and carries a concentrated point load \( W \) at a distance \( a \) from one end and \( b \) from the other end. Determine the fixing moments at the ends. Also, find the maximum deflection and the deflection under the load.

![Fig. 6](image)
2018-19
B.E. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
KINEMATICS OF MACHINES
EMEC-2120

Maximum Marks: 60  Credits: 03  Duration: Two Hours

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

Q.No.  Question  M.M.
1(a)  Differentiate between rigid and resistant bodies.  [03]
1(b)  What is Kutzbach’s criterion for degree of freedom of planar mechanism? In what way is Gruebler’s criterion different from it?  [04]
1(c)  What is an automobile steering gear? What are its types? Explain Davis steering mechanism with the help of diagram and evaluate its expression for correct steering action.  [08]
2(a)  State and prove Kennedy’s theorem as applicable to instantaneous centres of rotation of three bodies. How it is helpful in locating various instantaneous centres of a mechanism.  [05]

OR

2(a')  Explain the procedure of Klein’s construction to determine the velocity and acceleration of a slider-crank mechanism.  [05]
2(b)  The driving crank AB of the quick-return mechanism, as shown in Fig. 1, revolves at a uniform speed of 200 rpm. Find the velocity and acceleration of the tool-box R, in the position shown, when the crank makes an angle of 60° with the vertical line centres PA. What is the acceleration of sliding of the block at B along the slotted lever PQ? (All dimension in mm).  [10]
3(a)  Briefly explain the terms: function generation, path generation and motion generation.  [03]
3(b)  What do you mean by precision points in the design of mechanism? What is structural error?  [04]
3(c) Design a four-link mechanism if the motions of the input and output links are governed by a function \( y = x^{1.5} \) and \( x \) varies from 1 to 4. Assume \( \theta \) to vary from 30° to 120° and \( \varphi \) from 60° to 130°. The length of the fixed link is 30 mm. Use Chebyshev spacing of three accuracy points.

4(a) Discuss briefly interference in spur gears and derive the condition to avoid interference.

4(b) In an epicyclic gear train as shown in Fig. 2, the internal gears A and B and compound gear C - D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G. G gears with A and C and F gears with B and D. All the wheels have the same module and the numbers of teeth are: \( T_C = 28; T_D = 26; T_E = T_F = 18 \). If the arm G rotates at 100 r.p.m. in clockwise direction and A is fixed, find the speed of B.

OR

4(b') In a reverted epicyclic gear train as shown in Fig. 3, the arm A carries two gears B and C and a compound gear D - E. The gear B meshes with gear E and the gear C meshes with gear D. The number of teeth on gears B, C and D are 75, 30 and 90 respectively. Find the speed and direction of gear C when gear B is fixed and the arm A makes 100 r.p.m. clockwise.
of air at 110kPa and 293K, moving at an average of 6m/s. Estimate the pressure drop across the honeycomb. (See figure 4)

4(b). What are different types of losses? Derive the velocity profile for fully developed laminar flow in pipe in terms of maximum velocity and hence show that maximum velocity is two times the average velocity. Also prove that friction factor for laminar flow in pipes is inversely proportional to Reynolds number.
2018-2019
B. E. III Semester Examination
(Mechanical)
Fluid Mechanics -I
(EMEC-2310/EME-231)

Maximum Marks: 60 (Credits: 04) Duration: Two Hours

NOTE: Answer all the questions, symbols have their usual meaning.
Assume suitable data if missing.
Moody's diagram and sheets of mathematical identities are permitted.
**Clearly write all the assumptions before starting the solution.**

1(a). The 45° V-tube in Fig. 1 contains water and is open at A and closed at C. What uniform rotation rate in rev/min about axis AB will cause the pressure to be equal at points B and C? For this condition, at what point in leg BC will the pressure be a minimum?

![Fig 1](image)

1(b). The load-carrying capacity, W, of a journal bearing is known to depend on its diameter, D, length, l, and clearance, c, in addition to its angular speed, \( \omega \), and lubricant viscosity, \( \mu \). Determine the dimensionless parameters that characterize this problem.

2(a). Define pathline, streamline and streakline. Can streamline intersect each other, why or why not? If the flow is steady then what happen to these three lines.

2(b). Flow past a Rankine body is formed from the superposition of a uniform flow \( (U=20 \, \text{m/s}) \) in the +x dierction, and a source and a sink of equal strength \( (k=3\pi \, \text{m}^2/\text{s}) \) located on the x-axis at \( x=-a \) and \( x=a \), respectively. Find the half width of the body. Also find the velocity and pressure at the points \( (0, \, h) \), and draw the streamline pattern.

**Cont'd ... 2.**
2(a). Define the following terms briefly:

(a) Lagrangian flow description
(b) Material Derivative
(c) Circulation

2(b). A flow field is given by \( \vec{V} = ax\hat{i} - by\hat{j} \), where \( a = b = 1 \text{s}^{-1} \). Verify that the parametric equations for particle motion are given by \( x_p = C_1 e^{at} \) and \( y_p = C_2 e^{-bt} \). Obtain the equation for the pathline of the particle located at the point (x, y) = (1, 2) at the instant \( t=0 \).

3(a). An incompressible fluid flows past an impermeable flat plate, as in Fig. 2, with a uniform inlet profile \( u=U_0 \) and a cubic polynomial exit profile \( u \approx U_0 \left( \frac{3\beta - \beta^3}{2} \right) \), where \( \beta = y/\delta \). Compute the volume flow \( Q \) across the top surface of the control volume. Also calculate \( c_0 \) (coefficient of drag).

![Fig 2](image)

3(b). A 20°C water jet strikes a vane mounted on a tank with frictionless wheels, as in Fig. 3. The jet turns and falls into the tank without spilling out. If \( \theta = 30^\circ \), evaluate the horizontal force \( F \) required to hold the tank stationary.

![Fig 3](image)

3'. Derive Bernoulli's equation. State clearly the assumptions and its violation in different physical scenario.

4(a). For straightening and smoothening airflow in a 50cm diameter duct, the duct is packed with a honeycomb of thin straws of length 30cm and diameter 4mm. The inlet flow is
2018-19
B.E. (AUTUMN SEMESTER EXAMINATION)
MECHANICAL ENGG. IIIrd SEMESTER
MANUFACTURING TECHNOLOGY-I
EMEC-2410

MAXIMUM MARKS: 60 Credits:04 Duration: TWO HOURS

Answer all the questions.
Assume suitable data is missing
Notations used have their usual meanings

Q.No.  Marks

1 (a) With the suitable sketches discuss various patterns that are normally  [07]
considered in foundry practice.

1(b) A cylindrical riser must be designed for a sand-casting mold. The casting itself  [08]
is a steel rectangular plate with dimensions 7.5 cm × 12.5 cm × 2.0 cm. Previous  
observations have indicated that the total solidification time for this casting  
= 1.6 min. The cylinder for the riser will have a diameter-to-height  
ratio =1.0. Determine the dimensions of the riser so that its solidification time  
= 2.0 min.

1′(a) What are the functions served by gating system in any casting? Discuss different  [07]
types of gates used in sand casting process.

1′(b) Briefly explain the aspiration effect and methods to avoid aspiration in sand  [08]
mould casting. Drive the relationship between sprue diameters (top and bottom) and liquid heads for the limiting case to avoid the aspiration effect.

2(a) Explain the process of submerged arc welding (SAW) with a neat sketch and  [07]
explain how it is different from shielded metal arc welding (SMAW).

2(b) What are the defects that are generally found in welding? Discuss different  [08]
weld inspection and testing methods.

2′(a) Describe the types of flames obtained in an oxy-acetylene gas welding process  [07]
giving the application.

2′(b) Explain the TIG and MIG systems of arc welding. Give the applications of each.  [08]

contd....2.
3(a) Briefly explain the cold working, warm working, hot working and isothermal forming in metal forming also indicate some of the advantages of cold working relative to warm and hot working.

3(b) Using neat sketch briefly explain the process of wire-drawing and mention the names of different regions and angles on drawing dies. Determine the maximum possible reduction that can be made in one pass in drawing operation.

4(a) What is die swell in extrusion process? Briefly explain plastic sheet and film production processes.

4(b) In powder metallurgy process defines (i) interparticle friction (ii) true and bulk density of powder (iii) packing factor (iv) blending and mixing.