Maximum Marks: 60

Attempt all questions. Clearly mention the question numbers in the answer book. Assume suitably any missing data, if required.

1 (a) Explain the difference between DNC and CNC. What are their relative merits? [3]
(b) Describe the work envelope of a robot? How does it differ from one robot to another? [3]
(c) Write a part programme using G-M codes for the component shown in figure 1. The machining parameters are given below:
   Cutting Speed=1500rpm
   Feed=250mm/min
   Depth of cut=2 mm

OR

1' (a) Why flexible manufacturing system is also known as mini CIM? [3]
(b) State various types of manufacturing flexibilities. Explain any two types briefly. [3]
(e) What are the fixed cycles? Discuss how a fixed cycle can be useful in writing a part program. [6]

2 (a) The outline of the cam is shown in figure 2. It is to be milled using a two flute 1/2 inch diameter end mill.
   i) Write the geometry statements in APT to define the part outline. [3]
   ii) Write the motion statement sequence using the geometry elements defined in part (i). [3]

OR

2' (a) A profile milling operation is to be performed to generate the outline of the part. Two holes are also to be drilled on the part as shown in the figure 3. The part is 1/4 inch thick. Write the complete APT part programme to perform the profile milling and drilling operations. [6]
(b) What is group technology? Determine the form code (first five digits) in the Opitz system for the part shown in figure 4. [2, 4]

3 (a) Identify two manufacturing situations which are suitable for robot applications. Give your reasons. [2]
(b) Apply the rank-order clustering technique to the part-machine incidence matrix in the following table to identify part families and machine groups. Parts are identified by letters and machines are identified numerically. [4]
Machines | Parts
---|---
A | B | C | D | E | F | G | H | I
1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1
2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1
3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1
4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1
5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1
6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1
7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1
8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1

3 (c) Write note on the following:
   i. Taguchi loss function
   ii. Product liability
   iii. Operating Characteristics Curve

4 (a) Describe, with examples, some common methods of safeguarding metal working machinery.

(b) In an automatic filling, 175 grams of chemical has to be packed in containers. The permissible variation is ± 5 grams. To investigate the capacity of the process, samples of 5 each were drawn from 10 successive batches, and the data were recorded as given below:

<table>
<thead>
<tr>
<th>Batch</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>X</td>
<td>177</td>
<td>177</td>
<td>176</td>
<td>178</td>
<td>174</td>
<td>177</td>
<td>175</td>
<td>176</td>
<td>174</td>
</tr>
<tr>
<td>Range</td>
<td>R</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>2</td>
<td>8</td>
<td>5</td>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>

Assuming that the process is in control, establish the capability of the process and compare it with the stipulated specifications. Take \( d_2 = 2.326 \)

(c) Name some Non-Destructive testing techniques for inspecting internal flaws. Describe any ONE of them.

5 (a) What are inverted dies? What are their advantages and disadvantages over drop through dies?

(b) With the help of a neat diagram describe a leaf jig. Where may it be used?

(c) What is the function of stripper plates? How are they classified? With the help of a suitable diagram explain any ONE.

OR

5' (a) Write a detailed note on the principles of location applicable to jigs.

(b) What are the advantages of using hydraulic and pneumatic clamping devices over manually operating ones?

(c) What is meant by a built up construction of a jig and what is its advantage?
All dimensions in mm.

FIGURE 1

All dimensions in inch.

FIGURE 2

FIGURE 3

All dimensions in inch.
Spur gear
4.8 pitch circle diameter
(p.c.d: ϕ)
2012-2013
B.TECH. (VII SEMESTER) EXAMINATION
(MECHANICAL ENGINEERING)
POWDER METALLURGY
(ME-406)
Credits: 04

Maximum Marks: 60
Duration: Three Hours

Note: Answer all questions. All questions carry equal marks.

1. (a) Write down the uses and the name of the metal powders used in the following applications:
   i. Aerospace  
   ii. Electrical/electronic  
   iii. Heat treating  
   iv. Medical/Dental  
   v. Industrial  
   vi. Personal

(b) Consider the alternatives to powder metallurgy for the fabrication of lamp filaments from tungsten. Why are fusion techniques not applied to this product?

(c) Iron powder is screened to -100 to -100 mesh and -325 mesh fractions. The apparent density of the coarse fraction is 2.6 g/cm³. When a blend is prepared using 20% fine particles in the coarse fraction, the apparent density is measured as 2.8 g/cm³. Explain this effect.

2. Discuss the effect of compaction pressure on any two of the following:
   i. Porosity  
   ii. Number of contacts of a powder particle and its deformation  
   iii. Green density  
   iv. Green strength of powder compacts

3. Explain why powder particles sinter together at high temperatures. How does sintering alter the properties of the green compacts? Discuss all parameters that monitor the sintering process.

4. Differentiate between physical and physicochemical methods of powder production and explain any one of them in detail.

4f. Discuss in detail the applications of powder metallurgy in the following areas:
   i. Friction materials  
   ii. Structural parts  
   iii. Electric and magnetic components

5. Write detailed notes on any two of the following:
   i) Powder extrusion  
   ii) Powder rolling  
   iii) Smart materials by P/M processing

in the context of
2012-2013
B.TECH. AUTUMN (VII SEMESTER) EXAMINATION
(MECHANICAL ENGINEERING)
ADVANCED MECHANICS OF SOLIDS (ME-418)
Credits: 04

Maximum Marks: 60
Duration: Three Hours

Answer all questions. Assume any missing data.

1. Determine (i) the normal and shear stresses on a plane whose outer normal makes equal angles with x, y and z axes and (ii) the angle between T, and the outer normal n, if the cartesian components of stress at the point are: \( \sigma_x = \sigma_y = \sigma_z = 0 \), \( \tau_{xy} = 75 \, \text{MPa} \), \( \tau_{yz} = 0 \), \( \tau_{zx} = 160 \, \text{MPa} \).

OR

1(a) What do you mean by stress invariants? Explain.

1(b) The displacement field in a stressed body is given by: \( u = k(x^2 + 2x) \), \( v = k(4x + 2y^2 + z) \), \( w = 4kz^3 \), where \( k \) is a very small constant. Compute the strain at point \( (2, 2, 3) \).

2(a) What is the principle of superposition? Explain.

2(b) Derive an expression for the magnitude of couple \( M \) required to maintain the equilibrium of the linkage shown in figure 1.

3. Explain the theory of bending of curved beams and derive the Winkler-Bach's formula. State the assumptions made.

4(a) Derive the expression for the contact pressure in shrink-fitted composite tubes.

4(b) Derive the relations for the stresses set up in a uniformly rotating long circular shaft assuming the problem to be of plane strain type.

OR

4(b) A steel shaft of diameter 100mm is shrink inside a bronze cylinder of 250mm outer diameter. The shrink allowance is 1 part per 1000 (i.e. 0.05mm difference between the radii). Find the circumferential stresses in the bronze cylinder at the inside and outer radii and stresses in the shaft.
5(a) Explain in brief the thermo-elastic stress-strain relations for isotropic body.

5(b) Derive the relation for radial and hoop stress for a long circular cylinder.

OR

5(b') What is the theorem of stationary potential energy? Explain.
1. (a) Show with the help of diagram that effective head \( H \) of a centrifugal pump may be expressed as \( H = H_s + H_d + H_f + H_{i_d} + \frac{V^2}{2g} \). All terms have usual meaning. [04]

(b) A centrifugal pump impeller is 25 cm in diameter and the passage width at outlet is 2 cm. The blade angle at outlet is 45°, running at 1000 rpm. The discharge is 45 litres/s. Calculate the fraction of KE of discharge which is subsequently recovered in the casing. Neglect hydraulic friction and other losses. The pump is delivering against a head of 10 m. [08]

2. (a) Explain the phenomena of surging, choking and stalling. [04]
(b) A turbo compressor consumes 220 KW when pumping 1 kg/s of air from 1 kgf/cm² abs to 5 kgf/cm² abs. In the inlet duct, the air has a temp of 25°C and in the exit duct the velocity is 150 m/s calculate
   (i) static and total temp in exit duct,
   (ii) change of entropy and
   (iii) Isentropic efficiency based on static values
Assume negligible velocity at inlet and also negligible mech. losses.

OR

(b') Derive an expression for degree of reaction for an axial flow compressor and show that for reaction equal to 0.5, stationary and moving arc symmetrical. [08]

3. (a) A hydraulic lift raises the load of 8.75 tonnes at a speed of 0.50 m/s through a height of 13.5 m once in 96 sec, being worked from an accumulator which is fed by a pump of efficiency 80%. If pressure of water is 70 Kgf/cm² and efficiency of lift is 70%, find power input of pump and min. capacity of accumulator. Neglect the other losses. [06]
(b) Calculate the work saved in over coming friction by fitting large air used near the suction and delivery valves of reciprocating pump layout of following specification. Pump is single acting single cylinder speed - 60 rpm, stroke 35 cm, dia of cylinder = 20 cm delivery pipe is 10 cm diameter and 50 cm long and suction pipe is 15 cm diameter and 8 m long. Take \( \lambda = 4f = 0.04 \).

Contd.....2
4. (a) (i) Mention at least two differences between Francis's and Kaplan turbine. 
(ii) Write two functions of draft tube. 
(b) Following is the data pertaining to Francis turbine. Power = 10000KW, 
    Head = 200m, efficiency = 85%, speed = 540 rpm, 
    Velocity of flow at inlet = 9 m/s, efficiency hyd = 87%. 
    Ratio of wheel diameter to width at inlet = 10 
    Area occupied by thickness of blades = 7.5% of the area of water way. Find the 
    area, linear (tangential) velocity and the velocity of whirl at inlet and the angle of 
    entry. Discharge is radial. 

   OR 

4'. (a) (i) What is hydraulic similarity? 
(ii) What are different type of similarity laws? Write in short. 
(b) A Francis's turbine of diameter 3.0 m develops 6750 KW at 300 rpm under a net 
    head of 45m. A geometrically similar model of scale ratio 1:8 is to be tested at a 
    head of 9 m. Estimate the size, speed, discharge and power developed by the 
    model. What is the specific speed of model? Assume over all efficiency of model 
    and prototype is 82%. 

5. (a) Show that the efficiency of Pelton wheel is a maximum when the speed of the 
    bucket equals half the velocity of the jet. Also find the efficiency when bucket 
    deflects the jet by 120°. 
(b) A Pelton wheel 2.5 m diameter operates under the following conditions. 
    Net available head = 300 m, speed = 300 rpm. 
    Coefficient of velocity of jet = 0.98 
    Blade friction coefficient = 0.95 
    Blade angle = 165°, diameter of the jet = 20 cm. Mechanical efficiency = 0.95 
    Determine (i) Power developed (ii) Hydraulic efficiency 
    (iii) Specific speed. 

   OR 

(b') A Kaplan turbine runs under a head of 5.3 m and develops 7300 KW, the velocity 
    of flow is 6 m/sec and diameter of the hub is 0.36 of the external diameter. The 
    efficiency of the turbine is 87% and the peripheral speed of the blade external edge 
    is 20 m/sec. Determine (a) the speed in rpm, (b) specific speed and (c) diameter of 
    the wheel.
2012-2013
B. TECH: AUTUMN SEMESTER EXAMINATION
(MECHANICAL ENGINEERING)
GAS DYNAMICS
(ME-438)
CREDITS: 04

MAXIMUM MARKS: 60
DURATION: THREE HOURS

INSTRUCTION TO THE EXAMINEES
Answer all the questions, symbols have their usual meaning.
Assume suitable any missing data.
Use of gas tables, flow functions for computation of compressible flow.
Moody's diagram and sheets of mathematical identities is permitted.

1(a). In a Fanno Flow, if the inlet flow is supersonic and the duct length is made greater than the duct length is made greater than the $L_{max}$ to produce sonic flow, explain what happens to the flow in the duct.

1(b). A constant area duct, 20cm in length by 2cm in diameter, is connected to a reservoir through a converging nozzle, as shown in figure 1. For a reservoir pressure and temperature of 1 MPa and 500 K, determine the maximum air flow rate in kg/s through the system and the range of backpressures over which this flow is realized. Repeat these calculations for a converging nozzle with no duct. Assume $\gamma$ equal to 1.4.

OR

1(b'). A constant area duct is connected to a high pressure air pressure air reservoir through a converging nozzle. The walls of the duct are heated so as to supply 250KJ/kg to the air passing through the duct. If the reservoir pressure and temperature are respectively, 750KPa and 300K. If the system back pressure is 250KPa, determine whether or not the duct is choked. The duct diameter is 5cm and duct length is 1.2m. Also find the mass flow of air, assuming isentropic flow in the nozzle and frictionless flow in the duct.

2(a). Compute the lift and drag coefficient for a flat plate airfoil with $M_{∞}=2.5$, $c=1$m and $\alpha=10^\circ$. Draw a diagram showing the location of shock waves and expansion fans on the body.

2(b). A uniform supersonic flow at Mach 2.0, with static pressure of 75KPa and a temperature of 250K, expands around a 10$^\circ$ convex corner. Determine the downstream Mach number, pressure, temperature and the fan angle.

OR
2(b). What kind of oblique shock waves form in internal flows and what happens if the back pressure is reduced considerably?

3(a). Compare the loss in total pressure incurred by a one shock spike 2D diffuser with that incurred by a two shock diffuser operating at Mach 2. Assume that each oblique shock turns the flow through an angle of 10°. See figure 2(a) and 2(b).

3(b). Show the formation of shock waves using diagram on a blunt fore-body of a projectile for increasing Mach number.

4. Using infinitesimal disturbances theory, prove that the density propagates as a travelling wave with speed of \( a_0 = \sqrt{\frac{c}{c_0}} \). Also, enumerate mathematically the differences between compression and expansion waves.

Or

4'. Using finite disturbance theory, derive the momentum equation for a forward running wave. Further, discuss the progression of finite-amplitude disturbance.

5. Show that for a weak wave, Reimann invariants are

\[
\frac{u}{a_0} - \frac{1}{\gamma} \frac{p}{p_0} = \text{constant along } x - a_0 t = \text{constant}
\]

\[
\frac{u}{a_0} - \frac{1}{\gamma} \frac{p}{p_0} = \text{constant along } x + a_0 t = \text{constant}
\]

Also, discuss operation of shock tube using Reimann invariants.
B. TECH. AUTUMN SEMESTER EXAMINATION
(MECHANICAL ENGINEERING)
ARTIFICIAL INTELLIGENCE IN MANUFACTURING
(ME-449)

Maximum marks: 60  Credits: 04  Duration 03 Hours

Answer all questions. Assume suitably any data not provided.

1. (a) Consider the following statements:
   i. An academic program has many courses,
   ii. Each course is evaluated in grades,
   iii. The grade can be A or B or C or D or F,
   iv. If the grade is F, the course is to be repeated,
   v. When all courses are passed the degree is awarded,
   vi. Every graduated student is awarded either First division with Honours or First Division or Second division.

Express the above sentences in propositional logic and predicate logic.

(6 marks)

1. (b) What is CLIPS? Explain its essential features.

(6 marks)

OR

1*. Explain what is meant by expert systems? How are expert systems used in industry? Explain the types and elements of expert systems in detail with the help of examples.

(12 marks)

2. (a) In the context of Artificial Neural Networks explain the meaning of linearly separable and non-linearly separable problems with examples.

(6 marks)

2. (b) What is a hidden layer in a feed-forward neural network? How are hidden layers used and what are their benefits and limitations?

(6 marks)

OR
2'. For the training set given below, write the MATLAB code for training a feed-forward network. Assume all necessary data and information required for writing the code and give justifications for all assumptions. Show the network graphically.

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
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<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

(12 marks)

3. With the help of examples explain the meanings and uses of auto-correlators and hetero-correlators with special reference to manufacturing industry. Write an algorithm for training auto-correlators.

(12 marks)

4. How is fuzzy logic different from crisp logic? What are fuzzy sets and how are they used to design fuzzy controllers? Explain a few uses of fuzzy controllers in the following industries:

i. Transportation

ii. Manufacturing

iii. Household goods

iv. Insurance

(12 marks)
5. Assume two fuzzy sets, each defined by 10 numerical points with universe of discourse between 5 and 20. Show how various operations such as union, intersection and complement are done on these sets, both numerically and graphically, and discuss the use of such operations in industry.

(12 marks)

OR

5'. (a) Explain various ways in which rules may be framed for fuzzy controllers in real-world problems.

(6 marks)

5'. (b) What are implication operators? Distinguish between two widely used implication operators with regard to their use.

(6 marks)
Maximum Marks : 60

Note: (i) Answer all questions.
(ii) Assume suitable any data not given.

1. (a) Define (i) Brakes specific fuel consumption BSFC.
     (ii) Equivalent brake specific fuel consumption EBSFC.
     (iii) Propeller efficiency (iv) Taken off thrust.
     (b) Derive the equation for thrust transmitted through the structural support of engine.

2. A ramjet is to propel an air craft at $M_a = 3$ at high altitude where the ambient pressure is 8.5 KPa and ambient temp is 220K. Turbine inlet temp is 2540 K. If all components of the engine are ideal. Determine (i) thermal efficiency (ii) propulsion efficiency (iii) overall efficiency. If $\gamma = 1.4$ and value of $f < 1$.
   OR

   Draw the schematic diaig of Turbopropeller engine and discuss its advantages and disadvantages.

3. Derive the expression for thrust on inlet surface for external flow in subsonic inlets.
   OR

   At entrance to the burner the hydrogen is at 77K and in vapor form, air is at 600 K, determine the dependence of fuel air ratio $f$ and equivalence ratio $\phi$ on the turbine inlet temp in the range 1200 – 1800 K. Dissociation may be considered negligible, average sp heats may be assumed as:

   \[ \begin{align*}
   \text{H}_2 & \quad 30.2 \text{ KJ/K mol K} \\
   \text{O}_2 & \quad 33.8 \text{ KJ/K mol K} \\
   \text{N}_2 & \quad 32.0 \text{ KJ/K mol K} \\
   \text{H}_2\text{O} & \quad 40.0 \text{ KJ/K mol K} \\
   \end{align*} \]

   The heat of formation of $\text{H}_2\text{O}$ is : -241827 KJ/K mol.

4. Derive the equation for mass flow rate for two-phase flow of solids $\dot{m}_s$ and gaseous materials $\dot{m}_g$ on an incremental control volume. Also discuss the limiting solutions.

5. Discuss the working of any two:
   (a) Electron Bombardment Thruster
   (b) Chemical Rockets
   (c) Nuclear Rockets.