Q.No. Question                      M.M.
1(a) What are the advantages of combining CNC and AC? [03]
1(b) What do you understand by machine zero, work zero and home zero? Explain [03]
1(c) Prepare a part program using G-M codes for the part shown in Figure 1. Assume suitable machining data. [06]

![Figure 1](image)

2(a) Write the complete APT part program to perform milling and drilling operations for the part shown in Figure 2. The diameter of the hole is 10 mm and thickness of the job is also 10 mm. Assume suitable machining data. [08]

2(b) Describe the features of an industrial robot. Why are these features necessary? [04]

Contd........2
2'(a) Given the rotational part design as shown in figure 3, determine the form code in the Optiz parts classification and coding system. Dimensions are given in inches. Use table 1 for the codes.

2'(b) Differentiate between the following:
   i) Open loop and closed loop control system
   ii) AGV and AS/RS

Figure 2 (All dimensions in mm)

Figure 3
iii) Group technology and cellular manufacturing
iv) Drill and check surface

3(a) Define ‘flexibility’ as planning criteria for flexible manufacturing systems.
3(b) What is the need of DNC? How can it benefit CNC shop floor manufacturing?
3(c) What are the functions of following parts in press tool?
   i. Stripper
   ii. Pilots
   iii. Shredder
3(d) Define a defect in the context of product liability. Name some legal tests of whether a product is defective.

4(a) Define clearance and discuss its significance in a die and punch assembly?
4(b) Discuss the important factors to be considered while selecting a press.
4(c) What are chip breakers? What are their types? Enumerate their relative advantages and limitations.

OR

4'(a) With the help of neat sketches explain the importance and working of a diamond pin locator.
4'(b) Explain the need for drilling bushes. Discuss the various types of jig bushes commonly used along with their practical applications.

5(a) What do you understand by cost of quality? Discuss.
5(b) With the help of suitable examples, explain what is meant by the terms hazard and risk.
5(c) What is meant by a ‘robust design’? Explain its significance in TQM.
5(d) Write a detailed note on process capability.

TABLES ENCLOSED

Contd.....4
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<tr>
<th>Digit 1</th>
<th>Digit 2</th>
<th>Digit 3</th>
<th>Digit 4</th>
<th>Digit 5</th>
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<tr>
<td>Part class</td>
<td>External shape, external shape elements</td>
<td>Internal shape, internal shape elements</td>
<td>Plane surface machining</td>
<td>Auxiliary holes and gear teeth</td>
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<td>L/D ≤ 0.3</td>
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<td>No hole, no breakthrough</td>
<td>No surface machining</td>
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<td>Thread</td>
<td>Axial, not on pitch circle diameter</td>
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<td>Axial on pitch circle diameter</td>
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<td>Thread</td>
<td>Radial, not on pitch circle diameter</td>
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<td>Functional cone</td>
<td>Axial and/or radial on PCD and/or other directions</td>
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<td>All others</td>
<td>Bevel gear teeth</td>
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<td>All others</td>
<td>Other gear teeth</td>
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(PAPER CODE: 1687)

2013-14
B.TECH. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
POWDER METALLURGY

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

Q.N.O. Question M.M.
(a) "The P/M technology of metal processing is not a new one". Justify this statement with reasons. [03]
(b) What is the role of the inherent internal porosity in P/M products? How is this utilized in practice? Does the porosity behave in the same manner as that in castings? Explain. [05]
(c) What similarities and dissimilarities are found between powders and a solid or a liquid? [04]

2. Explain the following terms:
I. Sizing II. Impregnation III. Infiltration IV. Hot pressing
OR
2. Explain in detail the following methods of production of powders used in powder metallurgy:
I. Crushing II. Atomization III. Shoting IV. Chemical reduction [12]

Contd.....2
3. Write detailed notes on any two of the following:
   i) Powder extrusion  
   ii) Powder rolling  
   iii) Smart materials by P/M processing

OR

3. Explain the effects of following properties of metal powders on finished products:
   I. Particles size and its distribution  
   II. Flowability
   III. Chemical composition  
   IV. Sintering ability

4. Two different tungsten powders (Density~19.5 g/cm³) are analyzed for particle size using a streaming technique and found to have an equivalent mean size of 5µm. However, the other properties are quite different as given in the table:

<table>
<thead>
<tr>
<th>properties of the powders</th>
<th>Powder A</th>
<th>Powder B</th>
</tr>
</thead>
<tbody>
<tr>
<td>specific surface area, m²/g</td>
<td>0.26</td>
<td>0.12</td>
</tr>
<tr>
<td>apparent density, g/cm³</td>
<td>2.3</td>
<td>4.5</td>
</tr>
<tr>
<td>tap density, g/cm³</td>
<td>4.6</td>
<td>8.1</td>
</tr>
</tbody>
</table>

a) Explain the difference in surface areas.
b) What equivalent spherical diameter would give the same surface area? 
c) What difference in the powders might explain the packing properties? 
d) What additional information would be useful? [06]

(b) Differentiate between “mixing and blending”. Write down the variables involved in blending or mixing the powders. Illustrate the effect of the volume of powder and the rotational speed on relative rate of mixing using a cylindrical mixer. [06]

5. (a) Explain why powder particles sinter together at high temperatures. Discuss the various mechanisms involved during sintering process. [10]

(b) Draw the sintering profile for two spherical particles. If ‘R’ is the radius of the particles and ‘X’ be the neck size, then find out the neck radius ‘p’. [02]
2013-14
B.TECH. AUTUMN (VII SEMESTER) EXAMINATION
(MECHANICAL ENGINEERING—DE-I)
AUTOMOTIVE ENGINEERING
(ME-426)

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions.

Q.No.  M.M.
1(a) Describe briefly the classification of modern Automobile engines on the basis of  [04]
   i. No. of cylinder and cylinder arrangement
   ii. Type of ignition

1(b) Explain the working of hydraulic brakes with neat sketch and write the advantages  [08]
and disadvantages of hydraulic brakes over mechanical brakes.

OR

1'(a) What do you mean by balancing and firing order of I.C. engines? Write firing order  [06]
and power overlap of 4-cylinder engine. Discuss the basic difference between OHV
and OHC.

1'(b) What do you mean by cooling system of an I.C. engine? Explain the working of  [06]
different types of water cooling system and write the main function of radiator cap.

2(a) Explain briefly working of the following with neat sketch  [06]
   i. D-MPFI system
   ii. L-MPFI system

2(b) Sketch and explain the construction and working of a diesel fuel injector. What do  [06]
you understand by injector needle lift pressure? How does it affect the combustion.

OR

2'(a) What is the difference between air injection and solid injection? Explain the  [06]
working of common rail and individual pump injection system with neat sketch.

2'(b) Describe the working principle of jerk type of injection pump. Show the variation  [06]
of plunger helix during full, partial and no load condition.

Contd……….
3(a) What do you mean by ignition system of Automobiles? Explain the working of Magneto ignition system with the help of neat sketch and write advantages over battery ignition system.

3(b) What do you mean by optimum spark setting of a typical S. I. engine? Explain the working of vacuum advance mechanism.

4(a) With the help of neat sketch, explain the working of constant mesh gear boxes. Write advantages of constant mesh over sliding mesh gear box.

4(b) Explain the following:
   i. Synchronesh
   ii. Over drive
   iii. Transfer case

OR

4'(a) Explain the function of propeller shaft and differential axle.

4'(b) Describe the open and limited slip differential system. What is the problem associated with open differential system and how to overcome it.

5. Write short notes on the following:
   i. Telescopio Shock Absorber
   ii. Catalytic Converter
   iii. Power Steering
Maximum Marks: 60  Credits: 04  Duration: Three Hours

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

1(a) Discuss the various energy sources for power generation. [06]
1(b) Explain the working of Ocean Thermal Energy Conversion (OTEC) Systems. [06]

2(a) Discuss the working of a Locotiller boiler and a supercharged boiler. [10]
2(b) How is Supercritical boiler different from other boilers? [02]

OR

2'(a) Discuss the working of combined and cogeneration cycles. [10]
2'(b) What is tri-generation? Why cycles are not coupled in parallel? [02]

3 With neat sketches, discuss the ash and coal handling methods in a thermal power plant. What are the uses of ash? Explain the working of Electrostatic Precipitator. [12]

4 Discuss the working of Boiling Water Reactor (BWR) and Gas-Cooled Reactor (GCR). [12]

OR

4' Explain the working of Pressurized Water Reactor (PWR) and Liquid Metal Fast Breeder Reactor (LMFBR). Differentiate between thermal and fast breeder reactors. [12]

5(a) Discuss the various energy storage methods. [10]
5(b) Write a note on power plant economics. [02]
Max. Marks: 60

Note: 1) Answer all the questions. 2) All questions carry equal marks.
   3) Draw the neat sketches/diagram where needed.
   4) Velocity triangles are must where needed. 5) Mention clearly any assumption made.

1. (a) Evolve theoretical head discharge curve for various outlet blade angles of an impeller.
       
   (b) A centrifugal pump has an impeller of 18 cm outer diameter running at 1440 rpm and discharges water at 10 m³/min against a head of 9 m. The inner diameter is 9 cm, the vanes are set backward to outlet at 45°, area of flow is constant at 0.06 m², find:
       (i) efficiency manometric
       (ii) Vane angle at inlet
       (iii) least speed at which pump begins delivery.

2. (a) With the help of temperature entropy diagram show that for multi stage compressor the stage efficiency is greater than overall efficiency.
       (b) A multi stage axial flow compressor consumes 4.41 MW while delivering 20 Kg/S of air from stagnation condition of 1 Kg/cm² abs and 288 K. If polytropic efficiency of each stage is 0.9 with constant stagnation pressure ratio find:
           (i) pressure at compressor outlet
           (ii) Find no. of stages.
           Temperature rise in the first stage is 20°C.
           Neglect mechanical losses.

OR

(b') A turbo compressor handles 135 m³/min of free air delivering at the pressure of 6.8 N/cm² gauge, the suction temperature and pressure being 24°C and 9.5 N/cm² gauge abs. The barometer read 72 cm of Hg and the atmospheric temperature is 26°C. The adiabatic efficiency is 0.7, find:
       (i) final temperature of air
       (ii) Power required to drive the compressor if mechanical efficiency is 0.97.

3. (a) An accumulator has a ram of 300 mm diameter, an effective stroke of 6 m and is loaded with effective weight of 50 tonnes. If friction of ram amounts 3% of total load, find the total power delivered to hydraulic M/c, if ram falls steadily through the full stroke in 2 minutes while the pump delivers 2.5 l/s.

   (b) A single acting reciprocating pump has diameter of 30 cm and stroke 50 cm. It takes a supply of water from a sump 3.5 m below the pump axis through a pipe 10 m long and 20 cm diameter. If separation occurs at 2.5 m of water abs, Determine:
       (i) speed at which separation may take place
       (ii) change in speed of pump if an air vessel is fitted on the suction side 2.5 m above the sump water level. Take λ = 4f = 0.04. Barometric head = 10.3 m of water.

Contd....2,
4. (a) (i) What is run away speed in pelton turbine?
(ii) What is the function of spear valve?

(b) A Pelton turbine of 1.2 m mean bucket diameter works under a head of 650 m. The jet deflection is 165° and its relative velocity is reduced over the buckets by 15% due to friction. If the water is to leave the bucket without any whirl, determine
(i) rotational speed of the wheel
(ii) ratio of bucket speed to jet velocity,
(iii) impulsive force and power developed by the wheel
(iv) available power (water power) and the power input to the buckets.
(v) Efficiency of the wheel with power input to bucket as reference input. Take \( K_v = 0.97 \)

OR

(b') A Pelton wheel 0.9 m in diameter develops 675 kW. When operating under a head of 145 m and running at 500 rpm. The rate of flow of water through the nozzle is 0.55 m\(^3\)/s and the angle of deflection of the jet is 165°. If the friction and windage losses amounts to be 5% of velocity of jet, make an energy balance of the turbine. Take velocity coeff as -97.

5. (a) (i) Compare the impulse and reaction turbine. Write only two points.
(ii) Compare Francis and Kaplan turbine. Write only two points.

(b) A Kaplan turbine develops 10000 KW under a head of 12 m when the following condition prevail.
Speed ratio = 2, flow ratio = 0.65
Diameter of hub = 0.3 times the external diameter of vane.
Overall efficiency = 94%
Estimate,
(i) the speed (ii) the diameter of the runner and
(iii) the specific speed.

OR

(b') A runner of a Francis turbine having 1.5 m outer diameter and 0.75 inner diameter operates under a head of 150 m with specific speed of 120 and generates 14 MW. If the water enters the wheel at an angle of 11°20' and leaves the blade radially with no velocity of whirl, what will be the inlet and outlet blade angles? Assume hydraulic efficiency to be 92%.
2013-2014
B. Tech. (Autumn Semester) Examination
Mechanical Engineering
Ergonomics
ME 446

Duration: Three hours
Credits – 04

MM-60

Q.1 (i) Using Principles of ergonomics, discuss
(a) How a system can be improved?
(b) How a system can be designed to make it work better?
(ii) What do you understand by Displaying information? Explain in brief the different types of information presented by Displays.

OR

Q.1' Discuss in brief, any two of the following.
(i) Signal detection Theory
(ii) Human memory
(iii) Man-Man Communication System.

Q.2 (i) Discuss the factors affecting the energy consumption while performing work.
(ii) What is Biomechanics of human motion? Name and explain the different types of Motor Movements
(iii) Differentiate between Sensory feedback and Sensory Information

OR

Q.2' Explain the following.
(ii) Factors affecting Mental Workload.
(iii) Different types of Compatibility.

Contd........2
Q. 3 (i) What is Anthropometry? Write down the basic principles of using Anthropometric Data.
(ii) What are the principles of ergonomic design of workstation?
(iii) Discuss the variables and their limits which must be considered for design of a seating system. (4x3)

Q. 4 Explain any three of the following in brief:
(i) Illumination level for Video Display Terminals
(ii) Heat Illness
(iii) Noise and loss of hearing.
(iv) Vibration White finger (VWF) and its causes.
(v) Technical ways to reduce the hand arm vibration. (4x3)

Q. 5 (i) What are the different methods of reducing human error in working environment?
(ii) Name the different theories of accident causation and explain any one of them in detail.
(iii) Discuss the primary factors for the temporary impairment of driver's performance. (3x4)
Maximum Marks: 60                Credits: 04                Duration: Three Hours

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

Q.No.                Question                M.M.
1(a) Using Boolean operations on solid modelling primitives show the steps for creating
the solid model of a bracket shown in figure-1. (05)

Figure-1

OR

1(a') Discuss the CAD tools and the utilization of a CAD system in an industrial
environment. (05)

1(b) Write down the sequence of transformations for reflection about an arbitrary line.
Consider two lines passing through the origin with slopes $m_1$ and $m_2$ respectively
and show that if two pure reflection transformations about these lines are applied
successively, the result is a pure rotation about the origin. Find the angle of rotation. (07)

2(a) Discuss complex number modelling in kinematic analysis and synthesis. (03)

2(b) Determine the Chebychev's spacings for a four-bar linkage generating the function (09)
\[ y = \sin(x), \text{ in the range } 0^\circ \leq x \leq 90^\circ \] for three precision points. Further synthesize the mechanism using Freideinstein's equation. The range of motion for the input link is 120° and the range for the output link is 60°.

**OR**

2.\(b')\) A four bar mechanism shown in figure-2 is driven by a motor connected to a link 2, at 800 rpm clockwise. Angular acceleration of crank is 2000 rad/sec² clockwise. The position vectors for the links in a complex plane are:

\[ Z_2 = 2.5 \text{ cm } \angle 118.72^\circ, \quad Z_3 = 5.7 \text{ cm } \angle 2.01^\circ \]
\[ Z_4 = 5.0 \text{ cm } \angle 72.3^\circ, \quad Z_5 = 5.6 \text{ cm } \quad Z_6 = 3.4 \text{ cm} \]

![Figure-2](image)

Using complex numbers for analysis, determine the following:

(i) Linear velocity of point B
(ii) Angular velocity of the coupler
(iii) Velocity of the trace point P
(iv) Acceleration of Point B

3. Derive the expressions for natural coordinates in a Constant Strain Triangle (CST) element. Show that they are nothing but area coordinates.

**OR**

3'. Using polynomial functions (generalized coordinates) determine shape functions for a two noded beam element.
4.(a) Define the following:
   (i) Design constraints
   (ii) Constraint surface
   (iii) Objective function surface

4.(b) Discuss various Engineering applications of optimization.

4.(c) State the following LP problem in standard form:

Maximize \( f = -2x_1 - x_2 + 3x_3 \)
subject to
\[
\begin{align*}
    x_1 - 2x_2 + x_3 & \leq 8 \\
    3x_1 - 2x_2 & \geq -18 \\
    2x_1 + x_2 - 2x_3 & \leq 4 \\
\end{align*}
\]
x_1, x_2 are unrestricted in sign.

5.(a) What is artificial intelligence? Discuss the different approaches for artificial intelligence.

5.(b) Explain in detail the CAD process and the application of AI in CAD.

5.(c) What are knowledge based systems?