2015-16
B.TECH. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
POWDER METALLURGY
ME-406
Credits: 04
Duration: Three Hours

Maximum Marks: 60

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

Q.NO. Question
1. (a) Perfectly spherical Cu- powder of 75µm particle diameter is compacted by vibration.
   (i) What percentage of the theoretical density can be achieved?
   (ii) Will this increase or decrease if the particle diameter is uniformly increased to 2µm?
   [04]
1. (b) Explain the advantages of blending different metal powders.
   [04]
1. (c) What is screening of metal powders? Why is it done?
   [04]
2. (a) How does a ball mill function? With the help of neat sketches describe the possible configurations of balls in rotating ball mill depending on the speed of rotation.
   [06]
2. (b) Discuss the effects of lubricants on:
   (i) Apparent density and draw the respective curves with mixing
   (ii) Flow time and draw the respective curves with mixing times
   (iii) Green density achieved at compaction pressures of 200, 400 and 800 in MPa
   (iv) Ejection pressure in MPa for the same compaction pressures as in (iii)
   [06]
   OR
2'. (b) The aspressed density for a stainless steel powder is to be 6.5g/ cm³. The apparent density is 2.7g/ cm³. What is the compression ratio and what is the required powder fill for a final compact height of 40mm.
   [06]
3. Write detailed notes on any two of the following:
   i) Powder extrusion ii) Powder rolling iii) Smart materials by P/M processing
   [12]
4. Define sintering. Why powder particles sinter together at high temperatures?
   What is the effect of sintering time (at two different temperatures) on neck size, reduction in surface area, shrinkage and densification?
   [12]
5. Discuss in detail the applications of powder metallurgy in the following areas:
   I. Friction materials, II. Structural parts, III. Electric and magnetic components
   OR
   [12]
5'. Explain in detail the following terms:
   I. Impregnation II. Infiltration III. Hot Pressing
   [12]
2015-16
B. TECH. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
MECHANICAL VIBRATION
ME-411/417

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) Find the equivalent mass of the system shown in Figure-1. [05]

OR

(a’) Determine the Fourier series expansion of the periodic function shown in Figure-2. [05]

1 (b) A boy riding a bicycle can be modelled as a spring-mass-damper system with an equivalent weight, stiffness, and damping constant of 800 N, 50,000 N/m, and 1,000 N-s/m, respectively. The differential setting of the concrete blocks on the road caused the level surface to decrease suddenly, as indicated in Figure-3. If the speed of the bicycle is 5 m/s (18 km/hr), determine the displacement of the boy in the vertical direction. Assume that the bicycle is free of vertical vibration before encountering the step change in the vertical displacement. [07]

OR

1 (b’) A mass of 20 kg slides back and forth on a dry surface due to the action of a spring having a stiffness of 10 N/mm. After four complete cycles, the amplitude has been found to be 100 mm. What is the average coefficient of friction between the two surfaces if the original amplitude was 150 mm? How much time has elapsed during the four cycles? [07]

2 (a) A single-cylinder air compressor of mass 100 kg is mounted on rubber mounts, as shown in Figure-4. The stiffness and damping constants of the rubber mounts are

Contd....2.
given by and 2000 N-s/m, respectively. If the unbalance of the compressor is equivalent to a mass 0.1 kg located at the end of the crank (point A), determine the response of the compressor at a crank speed of 3000 rpm. Assume r = 10 cm and l = 40 cm.

2 (b) What are the vibration measuring instruments, explain in brief. Design a vibrometer to measure amplitudes at a lowest frequency of 10 Hz with an accuracy of at least 1.5%. Seismic mass is to be 1.0 Kg. Determine the stiffness of the spring and the damping coefficient of viscous damper in the system.

OR

2' Derive the equation of motion and discuss the response of a damped SDOF system subjected to Harmonic excitation. Draw the magnification factor and phase angle curves and explain their key points.

3 For the system shown in Figure-5 write down the differential equation of motion using coordinates x₁ and x₂ for mass m and 2m respectively. Also find the natural frequencies and their corresponding mode shapes. Further, if x₁ and θ at mass ‘m’, are used as coordinates find the type of coupling that exist.

4. (a) Derive the stiffness influence coefficient matrix of the system shown in Figure-6.

   (b) Using Dunkerley’s method, determine the fundamental natural frequency of the system shown in Figure-7.

5. (a) Derive an equation for the principal modes of longitudinal vibration of a uniform bar having both ends fixed.

   OR

(a') Derive the governing equation of motion for the free transverse vibration of a uniform beam based on Euler-Bernoulli beam theory.

5. (b) Using Holzer’s method find the natural frequencies of the system shown in Figure-8. Assume the following data: m₁ = 100 kg; m₂ = 20 kg; m₃ = 200 kg; k₁ = 8 kN/m; k₂ = 4 kN/m.

Contd….3.
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.  

1. The state of stress at a point is given by:  
\[ \sigma_{xx} = -120, \ \sigma_{yy} = 140, \ \sigma_{zz} = 66, \ \tau_{xy} = 45, \ \tau_{yz} = -65, \ \tau_{zx} = 25, \] all in units of MPa. Determine the three principal stresses and the associated directions. Also check on the invariance.

OR

1'. The state of strain at a point is given by:  
\[ \varepsilon_{xx} = 16, \ \varepsilon_{yy} = 07, \ \varepsilon_{zz} = 04, \ \gamma_{xy} = 08, \ \gamma_{yz} = 08 \ \text{and} \ \gamma_{zx} = 08. \] Determine the principal strains and the associated directions. Check on the strain invariants.

2. Explain the Begg's Deformer in detail with neat sketch.

OR

2'(a) What is fictitious load method? Explain it with an example.

2'(b) Determine the vertical force \( P \) which must be applied at \( G \) to maintain the equilibrium of the linkage shown in fig. 1.

3(a) For unsymmetrical beam bending, derive the following relation:  
\[ \sigma_{b} = (M_y / I_y) - (M_z / I_z) \]
The symbols have their usual meaning.

Contd......2.
3(b) Locate the shear centre from C.G. for the section shown in fig. 2. [06]

4(a) Express the stress equilibrium equation i.e.

\[
\frac{1}{r^2} \frac{d}{dr} \left[ r^2 \sigma_r \right] - \frac{2}{r} \sigma_\phi = 0
\]

in terms of the displacement component \( u_r \) using Hooke's law and strain-displacement relation. [06]

4(b) A long steel cylinder of outer radius 300 mm and inner radius 150 mm is rotating at an angular speed of 150 rad/s. The density of the material is 7700 Kg/m³ and the poisson’s ratio is 0.304. Calculate the maximum value of circumferential stress. [06]

5. Derive the relations for the radial and hoop stresses for a hollow sphere subjected to radial temperature variation. [12]

Contd...
Answer all the questions.

Q. No. Question M.M.

1(a) Explain in brief the need of firing order. Determine the firing-order of 12 cylinder 4-stroke in-line internal combustion engine. [6]

1(b) What are the requirements of an antifreeze mixture? Explain in detail the working of different types of water cooling systems. [6]

OR

1'(a) List all the functions performed by the lubricating oil in an engine. Discuss with the help of a suitable sketch the lubrication system. [6]

1'(b) Discuss with the help of a suitable sketch the antilock braking system with their advantages and disadvantages. [6]

2(a) Sketch and explain the construction and working of Bosch fuel injection pump. [6]

2(b) Explain in detail the MPFI system with the help of a suitable sketch. What are the advantages of MPFI system over the traditional carburetted system? [6]

OR

2'(a) Why air cleaner is attached to the air inlets of carburettors? Explain. What is the function of the exhaust manifold in automobiles? [6]

2'(b) Differentiate between:

1. Air injection and solid injection,
2. Fuel injection pump and fuel injector,
3. Air cleaner and fuel strainer

[6]

3(a) What are the basic requirements of an ignition system? What is the role of a spark plug in an ignition system? Describe its construction with a neat sketch. [6]
3(b) Describe the following:

1. Vacuum advance,
2. Centrifugal advance,
3. Dwell angle.

OR

3'(b) What are the functions of the following:

1. Condenser,
2. Distributor,
3. Ignition coil.

4(a) What are the requirements of a good clutch? Explain the working of cone clutch with the help of suitable sketch.

4(b) What are the advantages of constant mesh gear box over sliding mesh gear box? Describe the working of a 3-forward and 1-reverse speed sliding mesh type gear box.

5(a) Describe in detail the construction and working of a differential.

5(b) What is the purpose of suspension system in an automobile? Explain with the help of suitable sketch the working of catalytic converter.
2015-16
B.TECH. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
POWER PLANT ENGINEERING
ME 428

Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

Answer the following questions.
Assume suitable data if missing.
Notations used have their usual meaning.
Use of tables and charts is allowed.

Q.No.  

1(a) Discuss the criterion of site selection of a nuclear power plant. [4]
1(b) What are the advantages of hydro-electric power plants? [4]
1(c) What are the Direct energy conversion systems? Discuss the working of any one of the following. [4]
2(a) Discuss the working of cogeneration systems. Show the schematic diagram of a Combined Cooling, Heating and Power system (CCHP). [4]
2(b) Is it possible to connect two power plants in parallel, Give reasons. [4]
2(c) Derive an expression for three power plant cycles combined together. [4]

OR

2'(a) What do you understand by boiler efficiency? What are the different firing methods in a boiler? Explain any one of them. [4]
2'(b) What are the causes of heat loss in steam generators? [4]
2'(c) What are various steam turbine governing methods? How are they different from that of a hydroelectric power plant? [4]

3(a) Discuss the different coal handling methods in a thermal power plant. [6]

Contd....2.
3(b) Water at 30 °C flows into a cooling tower at the rate of 1.15 kg per kg air. Air enters the tower at the DBT of 20° C and a relative humidity of 60 % and leaves it at a DBT of 28° C and 90 % relative humidity. Makeup water is supplied at 20° C. Determine (1) the temperature of water leaving the tower, (2) the fraction of water leaving the tower and (3) the approach and range of the cooling tower. Use hygrometric chart.

4. What do you understand by uranium enrichment? Discuss the working of a Liquid Metal Cooled Fast Breeder Reactor (LMFBR). Which type of condenser is used in LMFBR. How are these reactors different from Pressurized Water Reactors (PWR) and Boiling Water reactors (BWR).

4'. Discuss the working of a Gas Cooled Reactor (GCR). Why is Zirconium alloy used in GCR. Throw light on different components used in a nuclear reactor and specifically the GCR.

5(a) What do understand by Mini- hydro? What do you understand by Load curve and load duration curve? Draw a load curve and show peaking load and average load. Which type of power plants are used as base load plants and peak load plants.

5(b) A power plant has the following annual factors: load factor = 0.75, capacity factor = 0.60, use factor = 0.65. Maximum demand is 60 MW. Estimate (1) the annual energy production, (2) the reserve capacity over and above the peak load and (3) the hours during which the plant is not in service per year.

5(c) Explain the effect of load factor on the cost of electricity generated. What is the straight-line method of determining the depreciation charge? What are the two basic parameters to decide while planning a power plant?
Maximum Marks: 60

Credits: 04

Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.
Draw the vector diagram where required.

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<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
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<tbody>
<tr>
<td>1(a)</td>
<td>Develope an expression for Euler' s Head for a turbomachine.</td>
<td>[06]</td>
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<td>1(b)</td>
<td>Make an energy balance in N-m/N of water for a Pelton turbine having</td>
<td>[06]</td>
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<td>following data: Power output = 735.5KW, H= 165m, KV=0.975, Mechanical</td>
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<td>friction &amp; Windage losses = 35000 N-m/s, Dm= 0.9m, N=500rpm, β2=15°,</td>
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<td>Q=560 L/s.</td>
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<td>2(a)</td>
<td>Prove that function of the draft tube is to permit a negative head to be</td>
<td>[06]</td>
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<td>established at the runner outlet.</td>
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<td>2(b)</td>
<td>A turbine runner has an exit velocity of 10 m/s. The loss of head due to</td>
<td>[06]</td>
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<td>friction &amp; other causes in the draft tube should not exceed 1.5m. What</td>
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<td>maximum height of setting will you recommend for the turbine if</td>
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<td>cavitation is to be avoided. Assume:</td>
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<td></td>
<td>i)velocity of water at outlet of draft tube is 2.5m/s (ii) cavitation</td>
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<td>commences when the pressure is 2.5m of water (iii) barometer reads 10.2</td>
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<td>m of water.</td>
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<td>3(a)</td>
<td>Show with the help of diagram that effective head &quot;H&quot; of a centrifugal</td>
<td>[06]</td>
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<td>pump may be expressed as H = Hs + Hd + Hf_a + Hf_d + v_d^2 /2g. All terms</td>
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<td>have usual meanings.</td>
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</table>
3(b) A centrifugal pump lifts water through 10m long, 150 mm dia pipe which is fitted with 90° bend. The max\textsuperscript{m} flow rate of pump is 75 l/s. Find the max\textsuperscript{m} static suction head if max\textsuperscript{m} permissible vacuum is 7.5 m of water. Loss in the bend is 8 cm of water, \(\lambda = 0.009\) for pipe.

4(a) With the help of sketch on T-S diag show that stage efficiency is greater than the overall efficiency of compressor.

4(b) An axial flow compressor has a degree of reaction 0.5 (at the mean radius) with relative air velocity angles of 130° & 100° at rotor inlet & outlet, the angles being measured in the direction of blade velocity. Overall stagnation pressure ratio is 3.5 & overall stagnation isentropic efficiency is 85% when the inlet stagnation temp is 330 K. The blade speed is constant at 200 m/s & flow velocity is also constant. Find the stagnation polytropic efficiency & number of stages. The work done factor is 0.85.

OR

4'(a) For an axial flow compressor with degree of reaction, \(R=0.5\), show that fixed & moving blades are symmetrical.

4'(b) Air at 24°C flows axially into the eye of impeller of a centrifugal compressor running at 18000 rpm & leaves the impeller with a velocity of whirl 0.88 times the velocity of blade tip. The outer dia of blade tip is 45 cm. Taking isentropic efficiency as 0.75, Find: (i) rise in temp of air (ii) static pressure ratio.

5(a) Answer briefly: (i) Why reciprocating pump operates at low speed? (ii) Under what condition slip becomes negative?. (iii) What are the advantages of air vessel on delivery side?. (iv) Draw the theoretical H-Q curve for Reciprocating pump.

5(b) An accumulator has a ram 300 mm in dia, an effective stroke of 6m & is loaded with a total weight of 50 tonnes. If friction of ram amounts to 3% of total load, find the total power delivered to the machine, if the ram falls steadily through its full stroke in 2 minutes while at the same time the pump delivers 2.5 l/s.
Assume data suitably, if required.

1(a) Define Production Systems and its sub-components. Explain how a production system is different from a manufacturing system?

1(b) An airline is planning to open a satellite ticket desk in a new shopping plaza, staffed by one ticket agent. It is estimated that requests for tickets and information will average 15 per hour, and request will have Poisson distribution. Service time is assumed to be exponentially distributed. Previous experience with similar satellite operations suggest that mean service time should average about three minutes per request. Determine each of the following:

(i) System Utilization
(ii) Percentage of time the server (agent) will be idle
(iii) The Expected number of customers waiting to be served
(iv) The average time customer will spend in the system
(v) The probability of zero customers in the system
(vi) The probability of Four customers in the system

OR

1'(a) Will doubling the service rate of a single channel system reduce the average waiting time in line by a factor of one-half? Explain.

1'(b) Develop a Mathematical Model to calculate throughput from a 2-station unpaced assembly line with a buffer of maximum capacity 01 in between the stations. Clearly state the assumptions made and notations used.

2(a) Explain the components of a Flexible Manufacturing System. Explain the difference between Flexibility and Automation.

2(b) Given a rotational part design in the Figure, determine the form code using the given coding scheme.
2'(a)  Give reasons for opting any part classification and coding techniques. How the advantages of Group Technology can be achieved by these coding and classification techniques. Which coding scheme is best suited for capturing manufacturing attributes and why?

2'(b)  For the given Part-Machine Matrix, calculate the Single Linkage Similarity Coefficient between the machines and hence draw the dendogram.
3(a) The net requirements for a material from an MRP schedule are:

<table>
<thead>
<tr>
<th>Weekly net requirements</th>
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<tr>
<td>1</td>
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<tr>
<td>300</td>
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</tbody>
</table>

The annual demand for this end item is estimated to be 30000 units over a 50 week per year schedule, or an average of 600 units per week. It costs $500 to change over the machines in the final assembly department to this end item when a production lot is begun. It costs $0.50 per unit when one unit of this product must be carried in inventory from one week to another; therefore, when one unit of this product is in ending inventory, it must be carried over as beginning inventory in the next week and incurs the $0.50 per unit carrying cost. Determine which of the following lot sizing methods results in minimum cost. Summarize the results in tabular form.

(a) Lot for Lot (LFL)
(b) Period Order Quantity (POQ)
(c) Economic Order Quantity (EOQ)
(d) Least Total Cost (LTC)

3(b) Describe MRP and discuss the various inputs which are required to prepare MRP. What information does the MPS contains? Explain.

4(a) Discuss the ten principles of Material handling by citing suitable examples.

4(b) Explain three of the following

(i) Dedicated and Random Storage Policy
(ii) Parameters assessing the Storage System Performance.
(iii) Pallet Load
(iv) AVG Guiding Mechanisms

5(a) Explain the following Blocks used in ARENA Simulation

(i) CREATE
(ii) ASSIGN
(iii) ADVANCE
(iv) DISPOSE

5(b) Explain how JIT systems differ from traditional production systems. Discuss some of the important obstacles that must be overcome in converting any traditional system into a JIT system.
B. TECH. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
ERGONOMICS
MF-446

Maximum Marks: 60

Duration: Three Hours

Answer all questions.

Q.No.  

1(a) What are the objectives of the ergonomics? Why the ergonomics is said to be multidisciplinary in nature? How can an industry be benefitted by using the principles of ergonomics.

1(b) List the consideration that should be kept in mind while performing a task? By giving suitable examples, discuss how different tasks can be improved by using ergonomics.

OR

1'(a) Define a display and give the main types of information that can be presented by displays. As a system designer when would you prefer auditory and visual form of information displays?

1'(b) What do you mean by a model regarding information processing? Give the model of human information processing system. Discuss the signal detection theory.

2(a) Why the knowledge of physiology is important for an ergonomist? Discuss the different types of Human physiology needed in occupational task evaluation.

2(b) Explain the Muscle Physiology and contractibility of muscle. Further give the methods of measurement for physiological strain

Contd....2.
2' (b) Do you agree that Mental workload has an important role to play in an industry, justify your answer? What are the basic purpose and Criterion for measurement of workload?

3 (a) Define Anthropometry and discuss its importance? Differentiate between structural and functional body dimensions. Explain the principles important for the application of anthropometric data to design problem.

3 (b) What are the basic requirements for the design of work station in an industry? Explain using a suitable example.

4 (a) How noise pollution has become a matter of concern for a worker performing task in an industry? Explain the causes for noise pollution? Also discuss its effects on human beings.

4 (b) How does illumination affects human performance. Discuss the considerations of lighting for Video Display Terminal (VDT).

OR

4' (a) Explain in brief that how climate is one of the major aspects of environmental conditions that affect comfort, health and performance, what is the cardiovascular response of the heat stress? Further discuss the different types of heat illness.

4' (b) What is the impact of vibration on the performance and Work related musculoskeletal disorders (WMSDs)? Explain the health effects of hand arm and whole body vibrations?

5 (a) What human errors are said to be responsible for the accidents which are increasing day by day. Discuss the classification of human errors. What precautions will you suggest for the drivers of automobiles?

5 (b) Different theories have been put forwarded for accidents causation; discuss any three of them in brief.