2018-19
B. TECH. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
CONTROL ENGINEERING
EE-305

Maximum Marks: 60 Credits: 04 Duration: Two Hours

Answer all questions. Assume suitable data if missing. Notations and symbols used have their usual meaning. Draw Bode plot on Semi-log graph paper.

Q.No. Question CO M.M.
1(a) What is the significance of developing a mathematical model for a control system? (CO1) (02)
1(b) Consider two carts on a frictionless wheels as shown in Fig.1. The carts are connected by damper a force F(t) is applied to one cart, derive the expression for the transfer function, considering displacement X1 as the output.

![Diagram of two carts connected by a damper with a force F(t) applied to one cart]

Fig.1.

1(c) Discuss the constructional features of Synchro and explain its operation. (CO1) (06)
2(a) Derive the transfer function of a block diagram shown in Fig.2 below using block diagram reduction technique (CO2) (08)

![Block diagram with multiple blocks and signals]

Fig.2.

2(b) Draw the signal flow graph of Fig.2, obtain transfer function using Mason’s gain formula. (CO2) (04)
3(a) Develop the state space model from the transfer function, armature controlled DC motor considering angular velocity as the output. (CO3) (06)
3(b) The system matrix for a control system is given by

\[
A = \begin{bmatrix}
0 & 1 & 0 \\
0 & 0 & 1 \\
-6 & -11 & -6
\end{bmatrix}
\]

Determine the characteristic equation and location of poles.

OR

Contd...
3'(a) Derive an expression for transfer function of the system from a given state model.
\[
\begin{bmatrix}
\dot{X}_1 \\
\dot{X}_2
\end{bmatrix} = 
\begin{bmatrix}
0 & 1 \\
-2 & -3
\end{bmatrix}
\begin{bmatrix}
X_1 \\
X_2
\end{bmatrix} + 
\begin{bmatrix}
0 \\
1
\end{bmatrix} U
\text{ and } [Y] = [0 \ 1]
\begin{bmatrix}
X_1 \\
X_2
\end{bmatrix}
\]

3'(b) Examine the controllability of the system represented as
\[
\begin{bmatrix}
\dot{X}_1 \\
\dot{X}_2
\end{bmatrix} = 
\begin{bmatrix}
2 & 3 \\
6 & -1
\end{bmatrix}
\begin{bmatrix}
X_1 \\
X_2
\end{bmatrix} + 
\begin{bmatrix}
1 \\
-2
\end{bmatrix} U
\text{ and } [Y] = [1 \ 2]
\begin{bmatrix}
X_1 \\
X_2
\end{bmatrix}
\]

4(a) The open loop transfer function of a system is given below, using Routh Hurwitz criterion determine the relation between K and T so that the unity feedback control system is stable.
\[G(s) = \frac{K}{S[S(S+10)+T]}\]

4(b) The forward path transfer function of a unity feedback control system is
\[G(s) = \frac{20}{(S^2+5S+5)}\]

Calculate Rise time, Settling time, and Maximum peak.

OR

4'(a) Differentiate between Relative stability and Absolute stability.

4'(b) Consider the Transfer function of a unity feedback control system. Using Routh Hurwitz criterion, determine the range of ‘K’ for which the system is stable.
\[G(s) = \frac{K}{S(S^2 + S + 1)(S + 4)}\]

4'(c) A second order control system is represented by transfer function,
\[\frac{\theta(s)}{T(s)} = \frac{1}{JS^2 + BS + K}\]
A step input of 10 NM is applied to the system, the time response parameters are obtained as, Maximum peak (M_p) = 6%, Peak time (t_p) = 1 Sec, steady state value of the output is 0.5 rad. Determine the values of J, K and B.

5(a) The transfer function of a unity feedback control system is represented as,
\[G(s) = \frac{1000}{S(1+0.1S)(1+0.001S)}\]

Draw Bode plot and determine
(i) Gain cross over frequency
(ii) Phase cross over frequency.
(iii) G.M and P.M, Comment on stability of the system.
2018-19
B.TECH. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
MACHINE DESIGN
ME-317

Maximum Marks: 60
Credits: 04
Duration: Two Hours

Answer all the questions.
Assume suitable data if missing.
Notation used have their usual meaning.
Use of graphs for hydrodynamic bearings is allowed.

Q. No. Question

1(a) A centrifugal clutch, transmitting 20 kW at 750 rpm consists of four shoes. The clutch is to be engaged at 500 rpm. The inner radius of the drum is 165 mm. The radius of the centre of gravity of the shoes is 140 mm, when the clutch is engaged. The coefficient of friction is 0.3, while the permissible pressure on friction lining is 0.1 N/mm². Calculate:
- Mass of each shoe, and
- Dimensions of friction lining.

1(b) A single block brake with a torque capacity of 15 N-m is shown in Fig. 1. The coefficient of friction is 0.3 and the maximum pressure on the brake lining is 1 N/mm². The width of the block is equal to its length. Calculate
- Actuating force.
- Dimensions of the block.
- The resultant hinge-pin reaction.
- The rate of heat generated, if the brake drum rotates at 50 rpm.
- State whether the brake is self-locking or not.

2(a) Define a bearing. How do we classify different types of rolling element bearings?

Figure: 1

contd... 2
2(b) With the help of neat sketches, explain the mechanism of oil film formation for the hydrodynamic lubrication of a sleeve bearing.

2(c) Stating the assumptions, drive the classical Reynolds equation for the hydrodynamic flow of lubricant along with the side leakage.

3(a) Derive the relations of maximum shear stress and deflection for helical compression springs.

OR

3(a') Derive the relations of bending stress for the full length and graduated leaves of the leaf spring, considering the same deflection in all the leaves. Also, obtain the relation of deflection.

3(b) Design a helical compression spring for a maximum load of 1000 N for a deflection of 25 mm using the value of spring index as 5. The maximum permissible shear stress for the round spring wire is 420 MPa and modulus of rigidity is given as 84 GPa.

OR

3(b') A semi-elliptical laminated vehicle spring to carry a load of 6000 N is to consist of seven leaves 65 mm wide, two of the leaves extending the full length of the spring. The spring is to be 1.1 m in length and attached to the axle by two U-bolts 80 mm apart. The bolts hold the central portion of the spring so rigidly that they may be considered equivalent to the band having a width equal to the distance between the bolts. The inner diameter of eye or diameter of pin is to be taken as 20 mm. Assuming that the leaves are not initially stressed, the design stress for the spring material is given as 350 MPa. Taking $E = 210$ GPa, determine
- thickness of the leaves
- deflection of spring
- length of the leaves

The standard thicknesses of the leaves are: 5, 6, 6.5, 7, 7.5, 8, 9, 10, 11 etc. in mm.

4(a) Derive Lewis Bending Equation, stating all the assumptions and with the help of appropriate force polygon.

4(b) A gear drive is required to transmit a maximum power of 22.5 kW. The velocity ratio is 1:2 and pinion is rotating at 200 rpm. The approximate centre distance between the shafts may be taken as 600 mm. The teeth has 20° stub involute profiles. The static stress for the gear material (which is cast iron) may be taken as 60 MPa and face width as 10 times the module. Find the module, face width and number of teeth on each gear. Check the
design for dynamic load. The deformation or dynamic factor in the Buckingham equation may be taken as 80. The velocity factor and the Lewis form factor may be taken as:

\[ C_v = \frac{3}{3+\nu} \]
\[ y = 0.175 - (0.841/T) \]

OR

4(b') A reciprocating compressor is to be connected to an electric motor with the help of cast iron spur gears. The distance between the shafts is to be 500 mm. The speed of the electric motor is 900 r.p.m. and the speed of the compressor shaft is desired to be 200 r.p.m. The torque, to be transmitted is 5000 N-m. Taking starting torque as 25% more than the normal torque, determine:

- Module and face width of the gears using 20 degrees stub teeth
- Number of teeth and pitch circle diameter of each gear.

Assume suitable values of velocity factor and Lewis factor. Also check the design for dynamic load, taking deformation or dynamic factor in the Buckingham equation as 80.
<table>
<thead>
<tr>
<th>Q. No.</th>
<th>Question</th>
<th>CO</th>
<th>M. M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Using Fourier's law of heat conduction, derive the relation for the rate of heat transfer through a plane wall, if the thermal conductivity varies with temperature according to the relation: ( k = k_0 (1 + \beta T) ). Draw the temperature distribution through the wall when thermal conductivity (i) remains constant with temperature (ii) increases with increase in temperature (iii) decreases with increase in temperature.</td>
<td>CO1</td>
<td>5</td>
</tr>
<tr>
<td>1(b)</td>
<td>Derive the required relations for temperature variation and heat transfer rate from a circular rod of infinite length. One end of this rod having (diameter 25mm) is inserted into a furnace while the remaining rod is projecting into a room at 22°C having convective heat transfer coefficient as 28.4 W/m²K. If at steady state conditions temperatures at 50 mm and 150 mm from furnace wall were found to be 110°C and 85°C, respectively, determine thermal conductivity of the rod material. Also find rate of heat dissipation by the rod and temperature at its base.</td>
<td>CO1</td>
<td>10</td>
</tr>
<tr>
<td>2(a)</td>
<td>Discuss time constant/sensitivity of a thermocouple for various conditions.</td>
<td>CO2</td>
<td>3</td>
</tr>
<tr>
<td>2(b)</td>
<td>A glow plug is centrally fitted in a cylinder cover of a diesel engine of 5 cm bore and 6 cm stroke to facilitate starting of an engine. The plug may be regarded as a piece of nichrome wire 3 mm in diameter and 6 mm in length having ( \epsilon = 0.95 ) when heated electrically to 1227°C. The temperature of the cylinder is 27°C, emissivity of the surface of bore 0.25 and that of the aluminum piston 0.15. Derive the relations for shape factor from glow plug to the piston crown and to the cylinder and then determine the radiation from the glow plug which is lost to the cylinder and the piston crown. Assume vacuum in the cylinder during the radiation heat transfer.</td>
<td>CO2</td>
<td>12</td>
</tr>
<tr>
<td>3(a)</td>
<td>With suitable diagrams explain Laminar- velocity and thermal boundary layers over a flat plate and inside tubes.</td>
<td>CO3</td>
<td>5</td>
</tr>
<tr>
<td>3(b)</td>
<td>Air flows through a long rectangular air conditioning duct 0.3m height x 0.6m width. If the duct is placed horizontally, exposed to ambient air at 25°C so that its outer surface temperature is maintained at 15°C, calculate heat gained by the duct per meter length. Use, ( Nu = 0.13(Gr.Pr)^{0.5} ) for vertical plane and ( Nu = C(Gr.Pr)^{0.4} ) for horizontal plane. Take ( C = 0.71 ) for upper surface &amp; ( C = 0.35 ) for lower surface. Properties of air at 20°C are ( \rho = 1.21 \text{ kg/m}^3 ), ( \nu = 15.06 \times 10^{-6} \text{ m}^2/\text{s} ), ( C_p = 1.005 \text{ kJ/Kg°C} ), ( k = 2.593 \times 10^{-3} \text{ W/m°C} ).</td>
<td>CO3</td>
<td>10</td>
</tr>
</tbody>
</table>
OR

3' Giving specific applications, explain Pool boiling, forced boiling, local boiling and bulk boiling. With neat diagram describe various regimes of Pool boiling showing critical heat flux and burn out points. Also show the boiling curves in case the system is power controlled and when it is temperature controlled. Show the bubble shapes on a sticking and a non-sticking surface.

4(a) Define effectiveness of a heat exchanger. Derive an expression for effectiveness of a parallel flow heat exchanger in terms of NTU and heat capacity ratio.

4(b) In a process industry a solution of density 1100 kg/m³ and specific heat 4.6 kJ/kg K is to be heated from 65 to 100°C. The required flow rate of the solution is 11.8 kg/s. A tubular heat exchanger is used for this with the solution flowing at about 1.2 m/s in 25mm bore iron tubes which is heated by wet steam at 115°C. Assuming inside and outside heat transfer resistance as 5 and 10 kW/m²K and neglecting the thermal resistance of the tube wall, estimate the number of tubes and the number of the tube passes required, if length of the tubes is not to exceed 3.5 m.

OR

4' With the help of some commonly used correlations, show the similarity between Sherwood number and Nusselt number. For a system where heat and mass transfer take place simultaneously, which may be when unsaturated air passes through or over a water surface, obtain the following relation:

\[
\frac{C_p \left( \frac{\alpha}{\delta} \right)^{\frac{1}{2}}}{h_{fg} \left( \frac{D}{L} \right)} = \frac{(\omega_\infty - \omega)}{(T_\infty - T_w)}
\]
Maximum Marks: 60  Credits: 04  Duration: Two Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.
Use of Mathematical Formula Sheets and Compressible flow charts are allowed.

Q.No.  Questions  CO  M.M.

1(a)  For a purely torsional (circumferential) incompressible flow, express \((\vec{V} \cdot \nabla)\vec{V}\) and \(\nabla^2 \vec{V}\) using cylindrical coordinates.

1(b)  Two long concentric circular cylinders enclose a viscous fluid \((\rho, \mu)\). If the inner (Radius, \(R_1\)) and outer (Radius, \(R_2\)) cylinders are rotating with constant angular velocities \(\omega_1\) and \(\omega_2\), obtain the velocity field so developed. Show that for \(\omega_1 > \omega_2 > 0\), non monotonic profiles are possible if \(\omega_2 R_2^2 > \omega_1 R_1^2\). State clearly the assumptions made.

OR

1(b)* Using scaling and dimensional analysis, transform Navier-Stokes equations for incompressible homogenous flow into non-dimensional form. For the above transformation, use non-dimensional dynamic pressure defined as \(\frac{p-p_0}{\rho U_s^2}\). For the limiting case of \(Re \to 0\), simplify the governing equations. Further, show that for flows with \(Re \to 0\), the dynamic pressure field and vorticity field satisfy Laplace equations.

2(a) For a Zero Pressure Gradient Boundary Layer over a flat surface, use momentum integral equation and the velocity profile given below to obtain expressions for boundary layer thickness \(\delta(x)\), Coefficient of skin friction \((C_f)\) and drag \((C_D)\) for certain length \(L\).

\[
\frac{u}{U_\infty} = A + B \left( \frac{y}{\delta} \right) + C \left( \frac{y}{\delta} \right)^2 + D \left( \frac{y}{\delta} \right)^3
\]

2(b) Show that near wall \(\frac{\partial u}{\partial x} < 0\) in a Boundary Layer (BL) over a flat surface for any pressure gradient. Hence

i. Prove that transverse velocity \((v)\) is always \(> 0\) inside a BL (hence, BL is...
deflected away from the wall)

ii. Show that in the neighborhood of flat surface, the transverse velocity \( v \) is proportional to \( y^2 \).

Discuss how the largest and smallest length and time scales are estimated in turbulent flows.

Show that the fluctuation velocity field is also divergence free in turbulent flows.

Consider thermal energy balance equation for incompressible homogenous flow given below:

\[ \frac{\partial T}{\partial t} + (\vec{V} \cdot \nabla)T = \kappa (\nabla^2 T) \]

Using Reynolds decomposition and ensemble averaging of the above equation, obtain the governing equation for mean temperature field. Also identify the extra terms.

In a steady inviscid compressible flow, the stagnation enthalpy, \( h_o = h + \frac{v^2}{2} \), of a fluid particle is conserved in time. Assuming, fluid to be a perfect gas, show that the possible states of a fluid particle, lie on an ellipse given as

\[ \frac{c^2}{\gamma - 1} + \frac{v^2}{2} = \frac{c_o^2}{\gamma - 1} \]

Plot the ellipse using \( V \) and \( c \) on x, y-axes respectively for \( V, c > 0 \). Show the sonic line demarcating sub-sonic and supersonic states on the ellipse in the above plot.

Air is expanded through a convergent-divergent nozzle from a large reservoir in which the pressure and temperature are 200 KPa and 310K respectively. A normal shock wave occurs at a point in the nozzle where the \( P \) is 11.7KPa. The air is then brought to rest in a second large reservoir. Find the pressure and temperature in this second reservoir. Clearly state the assumptions you have made in arriving at the solution.

OR

Air is expanded from a convergent-divergent nozzle from a large reservoir in which the pressure and temperature is 500 kPa and 45º C, respectively. The nozzle exit and throat area are 0.25 m² and 0.08 m² respectively. Use \( \gamma = 1.4, R = 287 \) kJ / kg K. Find:

(i) The design back-pressure and the temperature of the air leaving the nozzle with this back pressure.

(ii) At what back-pressure will there be a normal shock at the exit plane of the nozzle?
(iv) The back-pressure for which there are no shock waves in the nozzle.
(v) The range of back-pressure over which there are oblique shock waves in the exhaust from the nozzle.

4'(b) An asymmetrical wedge shaped nose of a body has its shape as shown in the figure with an air flowing at Mach number 3 and 20KPa. Find the pressure acting on both surfaces of the wedge.

\[ M = 3 \]
\[ P_o = 20\text{KPa} \]
2018-2019  
B. TECH. III Semester Examination  
(Mechanical)  
Economics and Management (ME340)  

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

NOTE: Answer all the questions, symbols have their usual meaning. Assume suitable data if missing.

Q.No.  
Questions  

1(a) Define briefly the following economic indicators  
a) Gross Domestic Product (GDP)  
b) Gross National Product (GNP)  
c) Inflation

1(b) A construction firm has decided to purchase a dozer to be employed at a construction site. Two different companies manufacture the dozer that will fulfill the functional requirement of the construction firm. The construction firm will purchase the most economical one from one of these companies. The alternatives have different useful lives. The cash flow details of both alternatives are presented as follows;  

Company-A Dozer: Initial purchase cost = Rs. 30,50,000, Annual operating cost Rs. 40,000 at end of 1st year and increasing by Rs. 2000 in the subsequent years till the end of useful life, Annual income = Rs. 5,60,000, Expected salvage value = Rs. 10,50,000, Useful life = 6 years.  

Company-B Dozer: Initial purchase cost = Rs. 40,00,000, Annual operating cost = Rs. 55,000, Annual revenue to be generated Rs. 5,50,000 till the end of useful life, Expected salvage value = Rs. 10,00,000, Useful life = 12 years.  

Using present worth method, find out the most economical alternative at the interest rate of 7% per year.  

2(a) A construction firm has purchased an equipment 3 year ago at a cost of Rs.6,00,000 and the estimated life and salvage value at the time of purchase were 11 years and Rs.1,60,000 respectively. The annual operating cost was Rs.19,500. The current market value of the equipment is Rs.4,40,000. The construction firm is planning for a major overhaul of the equipment now at a cost of Rs.1,00,000. After overhaul, the revised estimate of salvage value, annual operating cost and remaining life of the excavator are Rs.1,25,000, Rs.17500 and 9 years respectively.  

However the construction firm has the option to replace the current equipment with a new model. The initial cost of the new model is Rs.6,30,000. The estimated life, annual operating cost and salvage value are 9 years, Rs.15,000 and Rs.1,80,000 respectively. Determine whether the construction firm should continue with the existing equipment with the planned overhaul or replace it with the new model if the firm's MARR is 10% per year.
2(b) An asset for drilling was purchased and placed in service by petroleum production company. It cost basis is Rs. 60000 and it has an estimated market value of Rs. 12000 at the end of an estimated useful life of 14 years. Compute the depreciation amount in the third year and the book value at the end of Fifth year by using (i) Straight line method (ii) Double Declining Balance Method.

OR

2'(a) A state government is evaluating alternative routes for a new road having following options:

<table>
<thead>
<tr>
<th>Route</th>
<th>Construction cost ($S)</th>
<th>Annual Savings ($S)</th>
<th>Annual Recreational benefits ($S)</th>
<th>Annual access benefits ($S)</th>
<th>Annual maintenance cost ($S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>285000</td>
<td>8000</td>
<td>6500</td>
<td>1000</td>
<td>4500</td>
</tr>
<tr>
<td>B</td>
<td>310000</td>
<td>8000</td>
<td>7500</td>
<td>1000</td>
<td>5800</td>
</tr>
<tr>
<td>C</td>
<td>425000</td>
<td>9200</td>
<td>8000</td>
<td>2800</td>
<td>5200</td>
</tr>
</tbody>
</table>

The roads are assumed to have an economic life of 20 years. The interest rate normally required is 3% per year. Which route you select on the basis of B/C analysis?

2'(b) A material’s testing machine was purchased for $20,000 and was to be used for 8 years with an expected salvage value of $2000. Calculate depreciation charge for year 4 and the book value at the end of year 3 by using double declining balance method.

3(a) What do you mean by Management? If you have been appointed as a manager in an industry, what different skills you need to possess? Briefly discuss any three with appropriate situational examples.

3(b) What is the importance of group and Team Decision making in an organization, discuss its advantages and disadvantages. Explain the Delphi method of group decision making.

4(a) What do you understand by Departmentalization, Explain the different types of departmentalization employed in an organisation.

4(b) Explain the Maslow’s Hierarchy of need, Write down the motivational theory including the hierarchy of needs five stage model.

OR

4'(a) Explain Herzberg’s two factor Theory of Motivation.

4'(b) What do you understand by power in the context of leadership, what are its different types, explain in detail.

5(a) Discuss the importance of Marketing management. Further discuss the scope of marketing?

5(b) What is the meaning of Financial statement, discuss in detail.

OR

5'(a) What is Human resource Demand and supply, discuss in detail.

5'(b) What do you mean by Management of International Business?
2018-19
B. TECH. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
INDUSTRIAL ENGINEERING
ME 341

Maximum Marks: 60
Credits: 04
Duration: Two Hours

Note:
(i) Attempt all questions. Assume any suitable data, if needed.
(ii) Symbols have their usual meanings.
(iii) Marks allotted to each question and course outcome (CO) covered are indicated against each question.

Q. No. Question CO M. M.
1(a) List the (i) operation driven and (ii) customer driven strategies for improving the service productivity of an industry. CO1 4
1(b) What do you understand by product-process mix? Differentiate between job shop production and batch production. CO1 4
1(c) Explain function analysis in the context of value engineering. Draw a FAST diagram for a product of your own choice. CO1 4

OR

1'(a) The output of a process is valued at $100 per unit. The cost of labor is $50 per hour including benefits. The accounting department provided the following information about the process for the past three weeks. Calculate the multifactor productivity to determine whether recent process improvements had any effect and, if so, when the effect was noticeable.

<table>
<thead>
<tr>
<th>Units Produced</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor (hrs)</td>
<td>254.7</td>
<td>296.8</td>
<td>212.1</td>
</tr>
<tr>
<td>Material ($)</td>
<td>21,041</td>
<td>24,523</td>
<td>20,442</td>
</tr>
<tr>
<td>Overhead ($)</td>
<td>8,992</td>
<td>10,480</td>
<td>8,736</td>
</tr>
</tbody>
</table>

Contd...
1(b) What is a forced choice model of strategic planning for operations? Explain taking a suitable example. CO1 4

1(c) List down the defect theories used to prove a product liability case. Explain any one. CO1 4

2(a) A company is setting up an assembly line to produce 192 units per 8-hour shift. The following table identifies the work elements, times, and immediate predecessors.

<table>
<thead>
<tr>
<th>Work Element</th>
<th>Time (sec)</th>
<th>Immediate Predecessor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>40</td>
<td>None</td>
</tr>
<tr>
<td>B</td>
<td>80</td>
<td>A</td>
</tr>
<tr>
<td>C</td>
<td>30</td>
<td>D, E, F</td>
</tr>
<tr>
<td>D</td>
<td>25</td>
<td>B</td>
</tr>
<tr>
<td>E</td>
<td>20</td>
<td>B</td>
</tr>
<tr>
<td>F</td>
<td>15</td>
<td>B</td>
</tr>
<tr>
<td>G</td>
<td>120</td>
<td>A</td>
</tr>
<tr>
<td>H</td>
<td>145</td>
<td>G</td>
</tr>
<tr>
<td>I</td>
<td>130</td>
<td>H</td>
</tr>
<tr>
<td>J</td>
<td>115</td>
<td>C, I</td>
</tr>
</tbody>
</table>

CO2 6

2(b) What are the advantages and disadvantages of cellular layouts? CO2 3

2(c) Differentiate between part design attributes and part manufacturing attributes. CO2 3

3 Answer any two of the followings: CO3 6x2

(i) Describe various stages of a 'scheduling system' with the help of suitable examples.
(ii) Discuss, using examples, the role of work study in manufacturing industries.
(iii) Explain any two capacity planning techniques on the basis of numerical examples.
(iv) What is the role of 'environmental factors' in the 'Ergonomic Design' of an industrial system.

4(a) What is inventory control? Derive the relationships for 'Economic Order Quantity' and 'Re-order Point Level' for a 'Gradual Replacement' deterministic inventory control model. CO3 6

4(b) Define MRP. The gross requirements for a component in first, third, fifth, seventh and eighth period are 90, 100, 120, 100 and 90 respectively. The scheduled receipts for the second, fourth, sixth and seventh periods are 80, 90, 50 and 90 respectively. Seventy uncommitted items are available and the lead time is four periods duration. Establish a detailed material requirement planning (MRP) schedule. CO3 6

Cont'd ... 3
5(a)  "Quality is inversely proportional to variability". Explain taking a suitable example

5(b)  Differentiate between double sampling plan and sequential sampling plan.

OR

5'(a)  Differentiate between quality of design and quality of performance.

5'(b)  Draw the X-bar control chart for the data shown in the Table. Take control limit coefficient $A_2 = 0.58$

<table>
<thead>
<tr>
<th>SAMPLE k</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.02</td>
<td>5.01</td>
<td>4.94</td>
<td>4.99</td>
<td>4.96</td>
</tr>
<tr>
<td>2</td>
<td>5.01</td>
<td>5.03</td>
<td>5.07</td>
<td>4.95</td>
<td>4.96</td>
</tr>
<tr>
<td>3</td>
<td>4.99</td>
<td>5.00</td>
<td>4.93</td>
<td>4.92</td>
<td>4.99</td>
</tr>
<tr>
<td>4</td>
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5(c)  Starting from the initial trial solution $(X_1, X_2) = (0,0)$, apply the gradient search procedure to solve the following problem. Select an error tolerance to perform only three iterations.

Maximize \( f(X) = X_1 X_2 + 3X_2 - X_1^2 - X_2^2 \)