

Code No: Z0224/R07

Set No. 1

I B.Tech Supplementary Examinations, November 2009

MATHEMATICAL METHODS

( Common to Electrical & Electronic Engineering, Mechanical Engineering, Electronics & Communication Engineering, Computer Science & Engineering, Electronics & Instrumentation Engineering, Bio-Medical Engineering, Information Technology, Electronics & Control Engineering, Mechatronics, Computer Science & Systems Engineering, Electronics & Telematics, Electronics & Computer Engineering, Production Engineering, Instrumentation & Control Engineering and Automobile Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions  
All Questions carry equal marks

\*\*\*\*\*

1. (a) Express the following system in matrix form and solve by Gauss elimination method.  
 $2x_1 + x_2 + 2x_3 + x_4 = 6$ ;  $6x_1 - 6x_2 + 6x_3 + 12x_4 = 36$ ,  
 $4x_1 + 3x_2 + 3x_3 - 3x_4 = -1$ ;  $2x_1 + 2x_2 - x_3 + x_4 = 10$ .  
(b) Show that the system of equations  $3x + 3y + 2z = 1$ ;  $x + 2y = 4$ ;  
 $10y + 3z = -2$ ;  $2x - 3y - z = 5$  is consistent and hence solve it. [8+8]
2. Determine the eigen values and the corresponding eigen vectors of the matrix A, where  $A = \begin{bmatrix} 1 & 0 & -2 \\ 0 & 0 & 0 \\ -2 & 0 & 4 \end{bmatrix}$  [16]
3. Reduce the quadratic form  $3x^2 + 5y^2 + 3z^2 - 2yz + 2zx - 2xy$  to the canonical form and specify the matrix of transformation. [16]
4. (a) Find a positive root of the equation by bisection method:  $x^3 - 4x - 9 = 0$   
(b) Find the positive root of  $x^3 = 2x + 5$  by False Position method. [8+8]
5. (a) It is known that x, y are related by  $y = \frac{a}{x} + bx$  and the experimental values are given below:  
x: 1 2 4 6 8  
y: 5.43 6.28 10.32 14.86 19.5  
Obtain the best values of a and b.  
(b) Find the first two derivatives of the function tabulated below at x=0.6  
x: 0.4 0.5 0.6 0.7 0.8  
y: 1.5836 1.7974 2.0442 2.3275 2.6511 [8+8]
6. Find  $y(0.1)$ ,  $y(0.2)$ ,  $z(0.1)$ ,  $z(0.2)$  given  $\frac{dy}{dx} = x + z$ ,  $\frac{dz}{dx} = x - y^2$  and  $y(0) = 2$ ,  $z(0) = 1$  by using Taylor's series method. [16]
7. (a) Find the Fourier sine transform of  $e^{-ax} \cos x$ .  
(b) Find the Fourier cosine transform of  $x.e^{-ax}$ . [8+8]

Code No: Z0224/R07

**Set No. 1**

8. (a) Solve  $(x+y)p+(y+z)q=(z+x)$ .  
(b) Solve the difference equation, using Z-transform  $y(k+2)-2\cos\alpha.y(k+1)+y(k)=0$ ,  
given  $y(0)=1, y(1)=1$ . [8+8]

\*\*\*\*\*

*HowToExam.com*

Code No: Z0224/R07

**Set No. 2**

**I B.Tech Supplementary Examinations, November 2009**

**MATHEMATICAL METHODS**

**( Common to Electrical & Electronic Engineering, Mechanical Engineering, Electronics & Communication Engineering, Computer Science & Engineering, Electronics & Instrumentation Engineering, Bio-Medical Engineering, Information Technology, Electronics & Control Engineering, Mechatronics, Computer Science & Systems Engineering, Electronics & Telematics, Electronics & Computer Engineering, Production Engineering, Instrumentation & Control Engineering and Automobile Engineering)**

**Time: 3 hours**

**Max Marks: 80**

**Answer any FIVE Questions  
All Questions carry equal marks**

\*\*\*\*\*

1. (a) Express the following system in matrix form and solve by Gauss elimination method.  
 $2x_1 + x_2 + 2x_3 + x_4 = 6; 6x_1 - 6x_2 + 6x_3 + 12x_4 = 36,$   
 $4x_1 + 3x_2 + 3x_3 - 3x_4 = -1; 2x_1 + 2x_2 - x_3 + x_4 = 10.$   
(b) Show that the system of equations  $3x + 3y + 2z = 1; x + 2y = 4;$   
 $10y + 3z = -2; 2x - 3y - z = 5$  is consistent and hence solve it. [8+8]
2. For the matrix  $A = \begin{bmatrix} 4 & 1 & 0 \\ 1 & 4 & 1 \\ 0 & 1 & 4 \end{bmatrix}$ , determine matrix P such that  $P^{-1}AP$  is a diagonal matrix. [16]
3. (a) Show that every square matrix can be expressed as a sum of Hermitian and a skew Hermitian matrix.  
(b) If  $A = \begin{bmatrix} 2+3i & 1-i & 2+i \\ -2i & 4 & 2i \\ -4i & -4i & i \end{bmatrix}$ , then find a skew Hermitian matrix. [8+8]
4. (a) Find a positive root of  $x^4 - x^3 - 2x^2 - 6x - 4 = 0$  by bisection method.  
(b) Find an approximate root of  $x \log_{10} x - 1.2 = 0$  by Regula False method. [8+8]
5. (a) Fit a second degree parabola to the following data:  
x: 0 1 2 3 4  
f(x): 1 1.8 1.3 2.5 6.3  
(b) The velocity v of a particle moving in a straight line covers a distance x in time t. They are related as follows: Find  $f'$  (15).  
x: 0 10 20 30 40  
v: 45 60 65 54 42 [8+8]
6. Find  $y(0.1)$  and  $y(0.2)$  from  $\frac{dy}{dx} = xy + y^2, y(0) = 1$  by using Runge-Kutta method and hence obtain  $y(0.4)$  using Adam's method. [16]

Code No: Z0224/R07

**Set No. 2**

7. Find the Fourier Transforms of  $f(x) = \begin{cases} a^2 - x^2; & |x| < 1 \\ 0; & |x| > 1 \end{cases}$

Deduce that

$$\int_0^{\infty} \frac{\sin t - t \cos t}{t^3} dt = \frac{\pi}{4}. \text{ Using Parseval's identity prove that } \int_0^{\infty} \left( \frac{\sin t - t \cos t}{t^3} \right)^2 dt = \frac{\pi}{15}. \quad [16]$$

8. (a) Form the partial differential equations by eliminating the arbitrary constants

i.  $x^2 + y^2 + (z - c)^2 = a^2$

ii.  $z = (x^2 + a)(y^2 + b)$

- (b) Find the Z-transform of the sequences  $\{x(n)\}$  where  $x(n)$  is

i.  $\left(\frac{1}{3}\right)^n$

ii.  $(3)^n \cos \frac{n\pi}{2}$ .

[8+8]

\*\*\*\*\*

Code No: Z0224/R07

**Set No. 3****I B.Tech Supplementary Examinations, November 2009****MATHEMATICAL METHODS**

( Common to Electrical & Electronic Engineering, Mechanical Engineering,  
 Electronics & Communication Engineering, Computer Science &  
 Engineering, Electronics & Instrumentation Engineering, Bio-Medical  
 Engineering, Information Technology, Electronics & Control Engineering,  
 Mechatronics, Computer Science & Systems Engineering, Electronics &  
 Telematics, Electronics & Computer Engineering, Production Engineering,  
 Instrumentation & Control Engineering and Automobile Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions  
 All Questions carry equal marks

\*\*\*\*\*

1. (a) Find the rank of  $\begin{pmatrix} 2 & -4 & 3 & -1 & 0 \\ 1 & -2 & -1 & -4 & 2 \\ 0 & 1 & -1 & 3 & 1 \\ 4 & -7 & 4 & -4 & 5 \end{pmatrix}$
  - (b) Solve the system of equations  $3x+y+2z=3$ ,  $2x-3y-z=-3$ ,  $x+2y+z=4$ . [8+8]
  2. (a) Determine the eigen values and eigen vectors of the matrix  $A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$
  - (b) If  $A = \begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix}$ , find  $A^{100}$  [8+8]
  3. Reduce the quadratic form  $3x^2 - 2y^2 - z^2 + 12yz + 8zx - 4xy$  to canonical form by an orthogonal reduction and state the nature of the quadratic form. [16]
  4. (a) Find a positive root of the following equation by bisection method  
 $x^3 - x^2 - 1 = 0$
  - (b) Find the interpolating polynomial  $f(x)$  from the table
- |      |   |   |    |    |
|------|---|---|----|----|
| x    | 0 | 1 | 4  | 5  |
| f(x) | 4 | 3 | 24 | 39 |
- [8+8]
5. (a) Fit a curve of the form  $i(d) = ad^n$  for the data:  
 d:      1720    2300    3200    4100  
 i(d):   655     789     1000    1164
  - (b) Evaluate  $\int_0^3 \frac{dx}{1+x^3}$  using Simpson's one-third rule, by dividing the range by choosing  $h=0.5$ . [8+8]
  6. Evaluate the values of  $y(1.1)$  and  $y(1.2)$  from  $y'' + y^2y' = x^3$ ;  $y(1)=1$ ,  $y'(1)=1$  by using Taylor series method. [16]
  7. Find the Fourier Transforms of  $f(x) = e^{-|x|}$  and deduce that  $\int_0^\infty \frac{\cos xt}{1+t^2} dt = \frac{\pi}{2} e^{-|x|}$ .  
 Hence show that  $F(xe^{-|x|}) = i \sqrt{\frac{2}{\pi}} \frac{2s}{(1+s^2)^2}$ . [16]

Code No: Z0224/R07

**Set No. 3**

8. (a) Form the partial differential equations by eliminating the arbitrary constants
- i.  $x^2 + y^2 + (z - c)^2 = a^2$
  - ii.  $z = (x^2 + a)(y^2 + b)$
- (b) Find the Z-transform of the sequences  $\{x(n)\}$  where  $x(n)$  is
- i.  $\left(\frac{1}{3}\right)^n$
  - ii.  $(3)^n \cos \frac{n\pi}{2}$ .
- [8+8]

★ ★ ★ ★ ★

HowToExam.com

Code No: Z0224/R07

Set No. 4

I B.Tech Supplementary Examinations, November 2009

MATHEMATICAL METHODS

( Common to Electrical & Electronic Engineering, Mechanical Engineering,  
 Electronics & Communication Engineering, Computer Science &  
 Engineering, Electronics & Instrumentation Engineering, Bio-Medical  
 Engineering, Information Technology, Electronics & Control Engineering,  
 Mechatronics, Computer Science & Systems Engineering, Electronics &  
 Telematics, Electronics & Computer Engineering, Production Engineering,  
 Instrumentation & Control Engineering and Automobile Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions  
 All Questions carry equal marks

\*\*\*\*\*

1. (a) Express the following system in matrix form and solve by Gauss elimination method.

$$2x_1 + x_2 + 2x_3 + x_4 = 6; 6x_1 - 6x_2 + 6x_3 + 12x_4 = 36,$$

$$4x_1 + 3x_2 + 3x_3 - 3x_4 = -1; 2x_1 + 2x_2 - x_3 + x_4 = 10.$$

- (b) Show that the system of equations  $3x + 3y + 2z = 1$ ;  $x + 2y = 4$ ;

$$10y + 3z = -2; 2x - 3y - z = 5 \text{ is consistent and hence solve it.} \quad [8+8]$$

2. (a) Find the eigen values and eigen vectors of the matrix  $A = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$

- (b) If  $A = \begin{bmatrix} 1 & 0 \\ 0 & 3 \end{bmatrix}$ , find  $A^{256}$ . [8+8]

3. Reduce the quadratic form  $3x^2 - 2y^2 - z^2 + 12yz + 8zx - 4xy$  to canonical form by an orthogonal reduction and state the nature of the quadratic form. [16]

4. (a) Using Lagrange's formula, fit a polynomial to the data

X:	0	1	3	4
Y:	-12	0	6	12

Also find y at x = 2.

- (b) If the interval of differencing is unity, prove that  $\Delta \tan^{-1} \left( \frac{n-1}{n} \right) = \tan^{-1} \frac{1}{2n^2}$ . [8+8]

5. (a) Fit a curve of the form  $i(d) = ad^n$  for the data:

d:        1720    2300    3200    4100

i(d):    655     789     1000    1164

- (b) Evaluate  $\int_0^3 \frac{dx}{1+x^3}$  using Simpson's one-third rule, by dividing the range by choosing  $h=0.5$ . [8+8]

6. (a) Using Euler's method, find  $y(0.2)$ ,  $y(0.1)$  given  $y' = x^2 + y^2$ ,  $y(0) = 1$

Code No: Z0224/R07

**Set No. 4**

- (b) Evaluate  $y(0.8)$  using R - K method given  $y' = (x+y)^{\frac{1}{2}}$ ,  $y = 0.41$  at  $x=0.4$ .  
[8+8]
7. (a) Find the Fourier sine transform of  $e^{-ax} \cos x$ .  
(b) Find the Fourier cosine transform of  $x.e^{-ax}$ . [8+8]
8. (a) Solve  $xp - yq = z$   
(b) Solve the difference equation, using Z-transform  $x(k+1) - 2x(k) = 1$ , given  $x(0) = 0$ . [8+8]

\*\*\*\*\*



Code No: Y0821/R07

**Set No. 1**

**I B.Tech Supplementary Examinations, November 2009**  
**INTRODUCTION TO CHEMICAL ENGINEERING**  
(Chemical Engineering)

**Time: 3 hours**

**Max Marks: 80**

**Answer any FIVE Questions**  
**All Questions carry equal marks**

\*\*\*\*\*

1. (a) What is the role of chemical engineer in food processing industry.  
(b) Explain briefly ideal solution.  
(c) Write short notes on flotation. [6+4+6]
2. (a) Define heat capacity and explain how to calculate mean heat capacity for gases.  
(b) Differentiate between  $C_p$  and  $C_v$  and also write the relation between these two for ideal gases.  
(c) Write short notes on equivalent mass. [6+6+4]
3. (a) Describe the boundary layer formation on a flat plate for a fluid stream.  
(b) State and explain the equation of continuity. [12+4]
4. (a) Explain the mechanism of heat transfer by conduction, convection and radiation.  
(b) Write the equation for the rate of heat flow by conduction. Explain the terms in it?  
(c) Write brief note on conductivities of solids, liquids and gases. [6+4+6]
5. (a) Explain mass transfer coefficient in terms of film coefficient.  
(b) Discuss about the flux equation for diffusion in gases and diffusion in liquids. [16]
6. (a) Explain with the help of suitable equations how to estimate the vapour and liquid composition for flash distillation.  
(b) How many ways the azeotropes are classified and how to separate them. [8+8]
7. (a) Write short notes on the fields of applications of liquid-liquid extraction.  
(b) In a ternary extraction system, what are the solute, solvent, and carrier?  
(c) What you understand about solute and raffinate?  
(d) Define and explain distribution coefficient. [4+4+4+4]
8. (a) Explain briefly adsorption equipment.  
(b) Write expressions for Freundlich and Langmuir isotherms. [16]

\*\*\*\*\*

Code No: Y0821/R07

**Set No. 2**

**I B.Tech Supplementary Examinations, November 2009**  
**INTRODUCTION TO CHEMICAL ENGINEERING**  
**(Chemical Engineering)**

**Time: 3 hours**

**Max Marks: 80**

**Answer any FIVE Questions**  
**All Questions carry equal marks**

\*\*\*\*\*

1. (a) Differentiate between frothers and Depressors.  
(b) What are the mixers used for mixing of dry powders.  
(c) Differentiate between Dodge crushers and Blake crusher. [6+4+6]
2. (a) Explain a combined detailed flow diagram of process.  
(b) State the different forms of energy associated with mass.  
(c) What are the steps to follow in energy balance calculations? [4+4+8]
3. Explain the physical significance of Reynold's number and describe Reynold's experiment. [16]
4. (a) Explain: convection, forced convection, Natural convection and heat transfer coefficient  
(b) Write the relation between overall heat transfer coefficient and individual heat transfer coefficients. Also mention the meaning of various terms in it. [9+7]
5. (a) Name the two mass transfer operations for the following phases in contact:  
i. liquid-liquid  
ii. solid-vapour.  
(b) Mention the similarities between various mass transfer operations.  
(c) Mass diffusion exists between various mass transfer operations. Explain with examples. [4+6+6]
6. Describe the criteria of selection of equipment for gas-liquid operation. [16]
7. Write the advantages or uses of:  
(a) Mixer settlers  
(b) Pulse column  
(c) Spray column  
(d) Rotating disc contactors. [4×4]
8. (a) Explain rotary drier with neat sketch.  
(b) Explain process of humidification and dehumidification with suitable example. [10+6]

\*\*\*\*\*

Code No: Y0821/R07

**Set No. 3**

**I B.Tech Supplementary Examinations, November 2009**  
**INTRODUCTION TO CHEMICAL ENGINEERING**  
**(Chemical Engineering)**

**Time: 3 hours**

**Max Marks: 80**

**Answer any FIVE Questions**  
**All Questions carry equal marks**

\*\*\*\*\*

1. Discuss briefly:
  - (a) Flotation
  - (b) Screening. [2×8=16]
2. Give details about humidity and saturation. [16]
3.
  - (a) Differentiate between pseudo-plastic and Dilatant fluids with suitable example.
  - (b) What are the time dependent fluids and explain with suitable examples.
  - (c) Write salient points of one dimensional flow. [6+6+4]
4. Write about types of evaporators in details. [16]
5.
  - (a) What are three main problems that exists when a gas and liquid flow through a packed bed? Discuss in detail about their effect on mass transfer and suggest ways of reducing them.
  - (b) Write overall mole balance at steady state for designing a packed absorption column, and explain the terms involved. [9+7]
6. Explain briefly:
  - (a) Venturi scrubber
  - (b) Spray column. [8+8]
7.
  - (a) Write short notes on selection of liquid-liquid contactors.
  - (b) Write short notes on selection of disperse phase. [8+8]
8.
  - (a) Define molecularity, order and rate of a reaction.
  - (b) Distinguish between elementary and non elementary reactions with suitable examples. [9+7]

\*\*\*\*\*

Code No: Y0821/R07

**Set No. 4**

**I B.Tech Supplementary Examinations, November 2009**  
**INTRODUCTION TO CHEMICAL ENGINEERING**  
**(Chemical Engineering)**

**Time: 3 hours**

**Max Marks: 80**

**Answer any FIVE Questions**  
**All Questions carry equal marks**

\*\*\*\*\*

1. (a) Explain the electro mechanical operation.  
(b) Differentiate between Geometric and Kinematic Similarities. [8+8]
2. (a) How do you classify energy associated with mass.  
(b) Derive Kirchoff's equation for effect of temperature on heat of reaction.[6+10]
3. (a) With the help of a neat figure discuss about the development of a boundary layer on a flat plate.  
(b) Write the expression for thickness of boundary layer if the boundary layer is laminar and turbulent, respectively. [12+4]
4. (a) Define capacity and economy.  
(b) Explain forward feed triple effect evaporator with suitable sketch. [6+10]
5. (a) Mass transfer may occurs in different ways, name any five.  
(b) What are phenomena that must exists in a mass transfer opeartion.  
(c) There are many similarities and differences between various mass transfer operations mention them. [5+3+8]
6. (a) What is differential distillation? Derive Rayleigh equation.  
(b) Explain briefly classification of gas-liquid contact equipment. [8+8]
7. Explain in detail about classification of industrial liquid-liquid contactors. [16]
8. (a) How many ways the crystallization takes place.  
(b) What are the steps involved for crystallization to takes place?  
(c) Write short notes on classification of crystallization equipment. [4+4+8]

\*\*\*\*\*

Code No: Z1821/R07

**Set No. 1**

**I B.Tech Supplementary Examinations, November 2009**  
**ENGINEERING MECHANICS**  
( Common to Metallurgy & Material Technology and Aeronautical Engineering)

Time: 3 hours

Max Marks: 80

**Answer any FIVE Questions**  
**All Questions carry equal marks**

\*\*\*\*\*

1. A 300 N vertical force is applied at the end of a lever which is attached to shaft at O as shown in figure 1. Determine

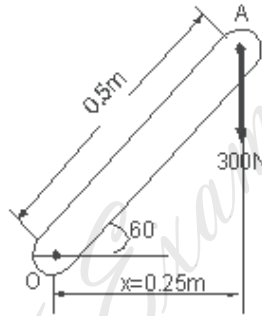


Figure 1

- (a) The moment of the 300 N force about O.  
(b) The magnitude of the horizontal force applied at A which creates the same moment about O.  
(c) The smallest force applied at A which creates the same moment about O. [16]
2. A block of mass 200 kg resting on a horizontal surface supports another block of 100 kg as shown in figure 2. The smaller block is attached to string from the wall. Find the horizontal force P just to move the 200 kg block to the left.  $\mu = 0.35$  for all rubbing surfaces. [16]

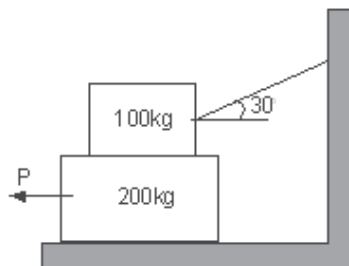


Figure 2

Code No: Z1821/R07

Set No. 1

3. Determine the width of a 9.75 mm thick leather belt required to transmit 15 kW from a motor running at 900 r.p.m. The diameter of the driving pulley of the motor is 300 mm. The driven pulley runs at 300 r.p.m. and the distance between the centre of two pulleys is 3 meters. The density of leather is  $1000 \text{ kg/m}^3$ . The maximum allowable stress in the leather is 2.5 MPa. The coefficient of friction between the leather and pulley is 0.3. Assume open belt drive and neglect the sag and slip of the belt. [16]
4. A hemisphere of diameter 30 cm is symmetrically placed on top of a circular cylinder of diameter 20 cm and height 30 cm. locate the center of gravity of the composite volume. [16]
5. (a) Starting from the first principles determine the moment of inertia of a triangle with respect to its base.  
(b) Determine the radius of gyration for rectangle
  - i. about x axis and
  - ii. about its base.[8+8]
6. The horizontal component of velocity of a projectile is twice its vertical component. Find the range on the horizontal plane through the plane of projection if the projectile passes through a point 18 m horizontally and 3 m vertically above the point of projection. Determine also initial velocity of the projectile. [16]
7. Two blocks are joined by an inextensible cable as shown in figure 7. If the system is released from rest, determine the velocity of block A after it has moved 2 m. Assume that  $\mu$  equals to 0.25 between block A and the plane and that the pulley is weightless and frictionless. [16]

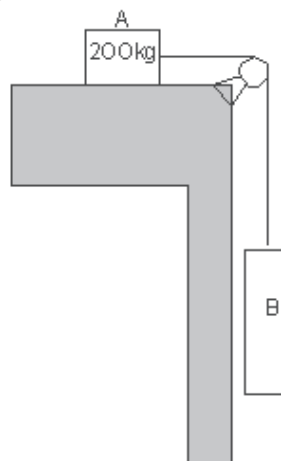


Figure 7

8. A shaft 1.5 m long is supported in flexible bearings at the ends and carries two wheels each of 50 kg mass. One wheel is situated at the center of the shaft and the other at the distance of 0.4 m from the towards right. The shaft is hollow of external diameter 75 mm and inner diameter 37.5 mm. The density of the shaft

Code No: Z1821/R07

**Set No. 1**

material is  $8000 \text{ kg/m}^3$ . The Young's modulus for the shaft material is  $200 \text{ GN/m}^2$ .  
Find the frequency of transverse vibration. [16]

\*\*\*\*\*

*HowToExam.com*

Code No: Z1821/R07

**Set No. 2**

**I B.Tech Supplementary Examinations, November 2009**  
**ENGINEERING MECHANICS**  
( Common to Metallurgy & Material Technology and Aeronautical Engineering)

Time: 3 hours

Max Marks: 80

**Answer any FIVE Questions**  
**All Questions carry equal marks**

\*\*\*\*\*

1. (a) Two forces are acting at a point O as shown in figure 1a. Determine the resultant in magnitude and direction.

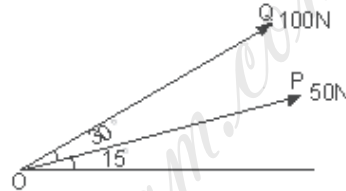


Figure 1a

- (b) Three forces of magnitude 40 KN, 15 KN and 20 KN are acting at a point O as shown in figure 1b. The angles made by 40 KN, 15 KN and 20 KN forces with X-axis are  $60^\circ$ ,  $120^\circ$  and  $240^\circ$  respectively. Determine the magnitude and direction of the resultant force. [8+8]

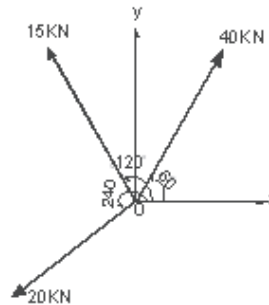


Figure 1b

2. (a) A wooden block weighing 30 N is placed on a horizontal plane. A horizontal force of 12 N is applied and the block is on the point of moving. Find
- Coefficient of friction
  - Angle of friction and
  - The resultant reaction.
- (b) A block of weight 80 N is placed on a horizontal plane where the coefficient of friction is 0.25. Find the force that should be applied to the block at an angle of  $30^\circ$  with the horizontal to attain the condition of limiting equilibrium. [8+8]
3. The power transmitted between two shafts 3.5 metres apart by a cross belt drive round the two pulleys 600 mm and 300 mm in diameters, is 6 kW. The speed of the



Code No: Z1821/R07

**Set No. 2**

larger pulley (driver) is 220 r.p.m. The permissible load on the belt is 25 N/mm, width of the belt is 5 mm thick. The coefficient of friction between the smaller pulley surface and the belt is 0.35. Determine necessary length of the belt, width of the belt and necessary initial tension in the belt. [16]

4. Find the centroid of the shaded area shown in figure 4. All dimensions are in mm. [16]

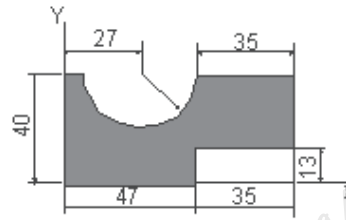


Figure 4

5. (a) Starting from the first principles determine the moment of inertia of a triangle with respect to its base.  
(b) Determine the radius of gyration for rectangle  
i. about x axis and  
ii. about its base. [8+8]
6. A bus starts from rest at point A and accelerates at the rate of  $0.9 \text{ m/s}^2$  until it reaches a speed of 7.2 m/s. It then proceeds with the same speed until the brakes are applied. It comes to rest, at point B, 18 m beyond the point where the brakes are applied. Assuming uniform acceleration, determine the time required for the bus to travel from A to B. Distance AB = 90 m. [16]
7. A spring is used to stop a 60 kg package which is sliding on a horizontal surface. The spring has a constant  $k = 20 \text{ kN/m}$  and is held by cables so that initially it is compressed to 120 mm. Knowing that the package has a velocity of 2.5 m/s in the position shown in the figure 7 and that the maximum additional deflection of the spring is 40 mm, determine.

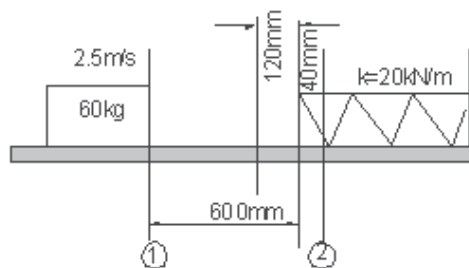


Figure 7

- (a) The coefficient of kinetic friction between the package and the surface.

Code No: Z1821/R07

**Set No. 2**

- (b) The velocity of the package as it passes again through the position shown. [16]
8. A shaft 1.5 m long supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external diameter 75 mm and the internal diameter 40 mm. The density of shaft material is  $7700 \text{ kg/m}^3$  and its modulus of elasticity is  $200 \text{ GN/m}^2$ . Find the lowest whirling speed of the shaft, taking into account the mass of the shaft. [16]

\*\*\*\*\*

*HowToExam.com*

Code No: Z1821/R07

Set No. 3

I B.Tech Supplementary Examinations, November 2009  
**ENGINEERING MECHANICS**  
( Common to Metallurgy & Material Technology and Aeronautical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions  
All Questions carry equal marks

\*\*\*\*\*

1. A 300 N vertical force is applied at the end of a lever which is attached to shaft at O as shown in figure 1. Determine

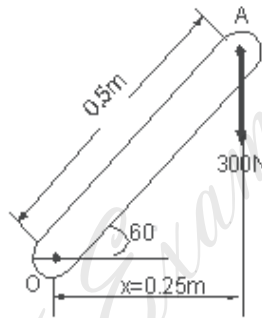


Figure 1

- (a) The moment of the 300 N force about O.  
(b) The magnitude of the horizontal force applied at A which creates the same moment about O.  
(c) The smallest force applied at A which creates the same moment about O. [16]
2. (a) A wooden block weighing 30 N is placed on a horizontal plane. A horizontal force of 12 N is applied and the block is on the point of moving. Find  
i. Coefficient of friction  
ii. Angle of friction and  
iii. The resultant reaction.  
(b) A block of weight 80 N is placed on a horizontal plane where the coefficient of friction is 0.25. Find the force that should be applied to the block at an angle of  $30^\circ$  with the horizontal to attain the condition of limiting equilibrium. [8+8]
3. Determine the width of a 9.75 mm thick leather belt required to transmit 15 kW from a motor running at 900 r.p.m. The diameter of the driving pulley of the motor is 300 mm. The driven pulley runs at 300 r.p.m. and the distance between the centre of two pulleys is 3 meters. The density of leather is  $1000 \text{ kg/m}^3$ . The maximum allowable stress in the leather is 2.5 MPa. The coefficient of friction between the leather and pulley is 0.3. Assume open belt drive and neglect the sag and slip of the belt. [16]

Code No: Z1821/R07

**Set No. 3**

4. In a rectangular plate  $10\text{ cm} \times 12\text{ cm}$ , as shown in figure 4 a rectangular opening PQRS  $3\text{ cm} \times 12\text{ cm}$ , is made. Find the centroid of the plate after the opening is made. [16]

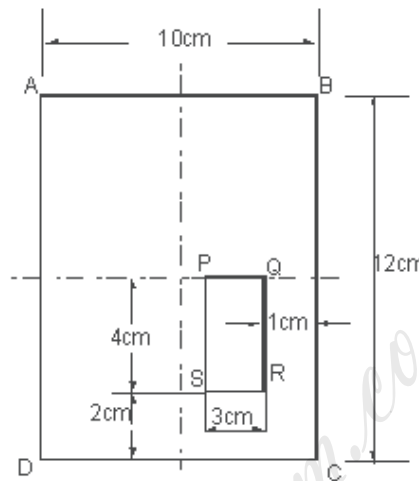


Figure 4

5. Calculate the mass moment of inertia of thin plate shown in figure 5 with respect to the axis X-X. Take mass of the plate as  $m$ . [16]

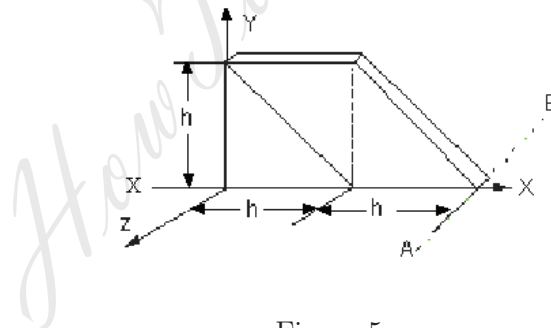


Figure 5

6. A bus starts from rest at point A and accelerates at the rate of  $0.9\text{ m/s}^2$  until it reaches a speed of  $7.2\text{ m/s}$ . It then proceeds with the same speed until the brakes are applied. It comes to rest, at point B,  $18\text{ m}$  beyond the point where the brakes are applied. Assuming uniform acceleration, determine the time required for the bus to travel from A to B. Distance  $AB = 90\text{ m}$ . [16]
7. Two blocks are joined by an inextensible cable as shown in figure 7. If the system is released from rest, determine the velocity of block A after it has moved  $2\text{ m}$ . Assume that  $\mu$  equals to  $0.25$  between block A and the plane and that the pulley is weightless and frictionless. [16]

Code No: Z1821/R07

Set No. 3

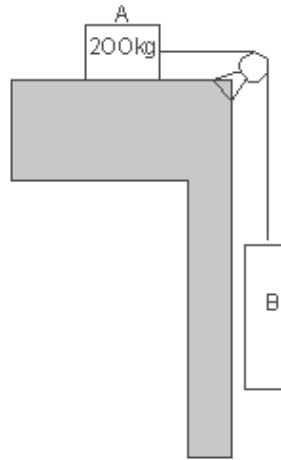


Figure 7

8. A cantilever shaft 50 mm diameter and 300 mm long has a disc mass 100 kg at its free end. The young's modulus for the shaft material is  $200 \text{ GN/m}^2$ . Determine the frequency of longitudinal and transverse vibrations of the shaft. [16]

\*\*\*\*\*

Code No: Z1821/R07

Set No. 4

I B.Tech Supplementary Examinations, November 2009  
**ENGINEERING MECHANICS**  
( Common to Metallurgy & Material Technology and Aeronautical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions  
All Questions carry equal marks

\*\*\*\*\*

1. Find the reaction at the supports A, B of the beam shown in figure 1. [16]

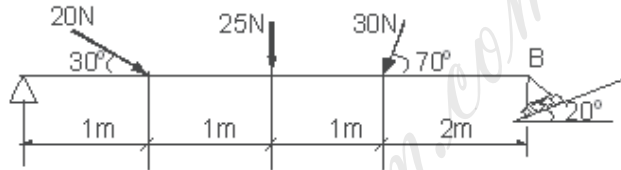


Figure 1

2. The cutter of a broaching machine is pulled by square threaded screw of 55 mm external diameter and 10 mm pitch. The operating nut takes the axial load of 400 N on a flat surface of 60 mm internal diameter and 90 mm external diameter. If the coefficient of friction is 0.15 for all contact surfaces on the nut, determine the power required to rotate the operating nut, when the cutting speed is 6 m/min. [16]
3. An open belt running over two pulleys 240 mm and 600 mm diameter connects two parallel shafts 3 metres apart and transmits 4 kW from the smaller pulley that rotates at 300 r.p.m. Coefficient of friction between the belt and pulley is 0.3 and the safe working tension is 10 N per mm width. Determine the minimum width of the belt, initial belt tension and length of the belt required. [16]
4. Determine the centroid of the section shown in figure 4. [16]

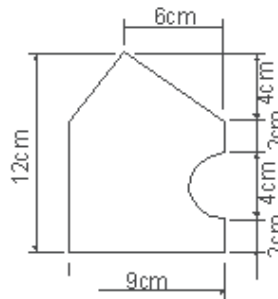


Figure 4

Code No: Z1821/R07

Set No. 4

5. (a) Starting from the first principles determine the moment of inertia of a triangle with respect to its base.  
(b) Determine the radius of gyration for rectangle  
i. about x axis and  
ii. about its base. [8+8]
6. A bus starts from rest at point A and accelerates at the rate of  $0.9 \text{ m/s}^2$  until it reaches a speed of  $7.2 \text{ m/s}$ . It then proceeds with the same speed until the brakes are applied. It comes to rest, at point B,  $18 \text{ m}$  beyond the point where the brakes are applied. Assuming uniform acceleration, determine the time required for the bus to travel from A to B. Distance  $AB = 90 \text{ m}$ . [16]
7. A spring is used to stop a  $60 \text{ kg}$  package which is sliding on a horizontal surface. The spring has a constant  $k = 20 \text{ kN/m}$  and is held by cables so that initially it is compressed to  $120 \text{ mm}$ . Knowing that the package has a velocity of  $2.5 \text{ m/s}$  in the position shown in the figure 7 and that the maximum additional deflection of the spring is  $40 \text{ mm}$ , determine.

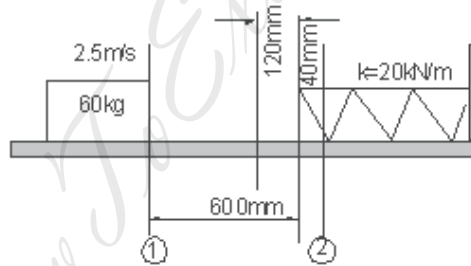


Figure 7

- (a) The coefficient of kinetic friction between the package and the surface.  
(b) The velocity of the package as it passes again through the position shown. [16]
8. Determine the natural frequency of the free longitudinal vibrations of a cantilever beam by equilibrium method and Rayleigh's method. [16]

\*\*\*\*\*