B.Tech. Examination-2023-24
Electronics and Communication Engineering Department
(Odd Semester Regular and Supplementary)

Course Title - Basic Electronics Engineering Course Code - ECEUGES01

Full Marks : 80 Time-3 hrs

(Answer any five, Symbols have their usual meaning)

1. (a) Explain electron-hole pair generation in intrinsic Si semiconductor at room temperature. 2
   (b) Compare between metal, semiconductor and insulator with respect to their band diagram. 4
   (c) How p-type semiconductor is formed ? 3
   (d) Draw and explain the majority and minority carrier concentration curve of it. 3
   (e) Explain why in p-type semiconductor the Fermi level energy E_F is close to the valence band edge E_v of the band diagram. 4

2. (a) Establish the following relation between drift velocity, mobility and electric field for an electron in a semiconductor under thermal equilibrium. 8
$$v = \mu_n E$$
   (b) Write down the drift and diffusion current expression of electron in a semiconductor 3
   (c) What is Einstein relation ? 3
   (d) What is its value at room temperature? 2

3. (a) Write the Fermi-Dirac distribution function. 5
   (b) Define Fermi-level. 2
   (c) Show that Fermi function is symmetrical about E_F i.e. $f(E_F + \Delta E) = 1 - f(E_F - \Delta E)$ 6
   (d) Write down the density of states function with energy E in 3D semiconductor crystal. 3

4. (a) Show that equilibrium concentrations of electrons (n_0) and holes (p_0) in a semiconductor can be expressed as :- 10
$$\text{(i) } n_0 = N_c e^{-\left(\frac{E_c - E_F}{KT}\right)} \qquad \text{(ii) } p_0 = N_v e^{-\left(\frac{E_F - E_v}{KT}\right)}$$
   (b) Show that the product of electron and hole concentrations under equilibrium is constant and can be expressed as :- $n_0 p_0 = n_i^2$. 3
   (c) Draw and explain the ideal diode characteristics in forward bias and reverse bias. 3

5. (a) Write down Shockley diode equation for p-n junction diode. 2
   (b) Show that diode dynamic resistance in forward bias is $r_d = \frac{26mV}{I_D}$. 3
   (c) Show that cut-in voltage of p-n junction diode is expressed as : 3
$$V_\gamma = V - \eta V_T \left(1 - e^{-\frac{V}{\eta V_T}}\right)$$
   (d) Determine the diode dynamic resistance 'r_d' and cut-in voltage 'V_γ' of the forward-bias diode at room temperature with the following parameters :- 4+4
   $I_S = 1\,nA$, $\eta = 1$, near the region where the diode current is $2\,mA$.

6. (a) Explain the formation of depletion region and barrier potential V_0 in a p-n junction diode under equilibrium. 8
   (b) Explain with diagram the forward bias and reverse bias characteristics of p-n junction diode. 8

7. (a) Draw and explain the output waveform of the circuit in Fig. 1. 5
   (b) Draw and explain the output waveform of the circuit in Fig.2. 6
   (c) What will be the output waveform of the circuit shown in Fig. 3. 5

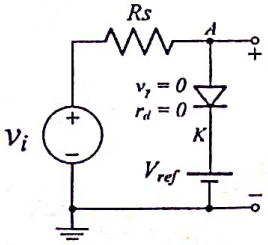


Fig. 1

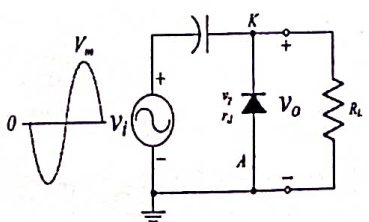


Fig.2

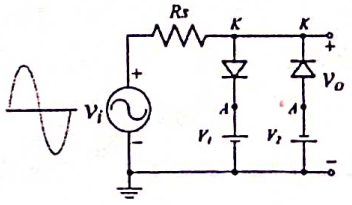


Fig.3

8. (a)	Explain the operation of full wave rectifier circuit using centre-tapped transformer.	7
(b)	Show that the output DC voltage (V_{dc}) and RMS value of full wave rectifier output is : (i) $V_{dc} = \frac{2V_m}{\pi}$ (ii) $V_{rms} = \frac{V_m}{\sqrt{2}}$	6
(c)	What are the advantages of bridge rectifier over centre-tapped transformer full-wave rectifier ?	3
9. (a)	Explain different current components in a p-n-p transistor in active region with a suitable diagram.	6
(b)	Establish the relation between current amplification factors α and β.	4
(c)	Briefly explain the CB, CE and CC mode of operation in a transistor.	6
10(a)	What are the ideal characteristics of OPAMP?	4
(b)	Define CMRR and find the expression of CMRR in terms of input voltages.	5
(c)	Derive an expression of voltage gain of an inverting amplifier.	7
11(a)	Derive an expression for closed loop gain of a feedback amplifier.	6
(b)	Show that negative feedback in amplifier increases stability of the circuit.	5
(c)	Derive the expression of input impedance of voltage series feedback amplifier.	5
12(a)	Explain the construction and operation of n-channel JFET with suitable diagram.	8
(b)	Define ac drain resistance, transconductance and amplification factor of FET and find relation between them.	5
(c)	For an n-channel JFET $I_{DSS} = 8.7mA$, $V_p = -3V$ and $V_{GS} = -1V$. Find the value of I_D, g_{mo} and g_m .	3

AUTUMN SEMESTER EXAMINATION-2023

Course Code: **PHYUGBS01**
Course Title: Engineering Physics
Department of Appearing Students: CEN, EEN, MEN, ECE, CSE, 1st Year, SEM-I
Full Marks: **80** Time: **3 hrs**

Answer any EIGHT (O8) questions **10 X 8 = 80**

1. (i) Find the angle between **A=2i+2j-k** and **B=6i-3j+2k**
(ii) Determine the value of a so that **A=2i+aj+k** and **B=4i-2j-2k** are perpendicular.
(iii) Find the projection of the vector **A=i-2j+k** on the vector **B=4i-4j+7k**
(iv) Find out a unit vector perpendicular to the two vectors **–i+j+j** and **2i+3j+2k.**
(v) On application of a force **7i+2j-k** N, a particle moves from position **-4i+3j+6k** m to another position **2i-6j+5k.** Calculate the work done.

2x5=10

2. (i) Define Torque.
(ii) Prove that for a system of particles **L=Iω**, symbols are usual meanings.
(iii) Define Radius of Gyration.
(iv) A fly wheel of mass 500 kg and diameter 2 m is revolving at the speed of 500 rpm. If whole mass of the wheel is concentrated at the edge, calculate its (a) angular velocity, (b) moment of inertia, (c) energy.

2+3+2+3=10

3. (i) Define Viscosity of liquid.
(ii) What is Critical Velocity?
(iii) State and prove Stoke's law. 2+2+6 =10

4. (i) State Coulomb's law in electrostatics.
(ii) Defile electric line of force and write its properties.
(iii) State and prove Gauss's theorem in electrostatics. 2+(2+2) +4 =10

5. (i) Calculate the Electric field due to a uniformly charged sphere using the Gauss's law.
(ii) Define Electric dipole.
(iii) Calculate the electric field in free space due to electric dipole at axial point. 4+2+4=10

6. (i) Derive the expression for the fringe width in a Young's double slit experiment.
(ii) Define 'Fringes of equal thickness' (FET).
(iii) What is the difference between Fraunhofer diffraction and Fresnel diffraction? 5 +2+3=10

OR

(i) What is interference of light? Using the theory of superposition of wave, derive the condition of constructive and destructive interference.
(ii) Write Huygens principle of wave optics. What are the secondary wavelets

(3+6) +(2+2) = 10

7. (i) Define H-polaroid.
(ii) An EM waves $E_x(z,t) = E_{0_x}\cos(kz - \omega t)$ and $E_y(z,t) = E_{0_y}\cos(kz - \omega t + \delta)$. Find the state of polarization in following cases$(a)\ \delta = 0, E_{0_x} \neq E_{0_y};\ \ (b)\ \delta = \frac{\pi}{2}, E_{0_x} = E_{0_y};$
(iii) How would you combine two linear vibrations to get circular vibration?
(iv) A plane polarized light become circularly polarized light by passing through a crystal of thickness $3 \times 10^{-3} cm$. Calculate the difference in refractive indices for E ray and O ray if $\lambda = 6000\text{Å}$.

2+(2+2) +2+2=10

OR

(i) Derive the expression of intensity $I = I_0 \frac{\sin^2 \alpha}{\alpha^2}$ in single slit diffraction, where $\alpha = \frac{\pi a}{\lambda}\sin\theta$.
(ii) Using the formula derive the position of primary minima of the diffraction pattern

5+5 = 10

8. (i) What is Einstein's A, B co-efficient? Derive a relation between them.
(ii) Discuss what the basic difference between spontaneous and stimulated emission are.
(iii) How population inversion is obtained in practical lasers? (2+4) +2+2 = 10

OR

(i) A monochromatic light of 300 nm is used in Young's double slit experiment. If the screen is placed at 100cm and the distance between two slits are 1 mm then find the fringe width, position 1st bright fringe.
(ii) A monochromatic light of 300 nm is used in single slit diffraction. If the slit width is 0.1 mm, then find the width of central diffraction maxima
(iii) Draw the combined pattern of diffraction and interference in Young's double slit experiment.

4+4+2 =10

9. (i) What is Mass defect of a nucleus? A Copper Nucleus has a mass number 64 and atomic number 29. The neutron and the proton mass are given as 1.0087 amu and 1.0073 amu. The mass of the copper nucleus is 63.546u. Calculate the mass defect and Binding energy of the Copper Nucleus. Given 1u =931.5 MeV.
(ii) Explain the Volume effect, Surface effect and Coulomb effect in Bethe Weizsäcker formula of semi empirical mass.

(2+3) + 5 = 10

10. (i) Write down the properties of nuclear force?
(ii) Define atomic number and mass number of an atom.
(iii) The mass number of an atom is 40. Find the nuclear radius? 4+2+3 =10

11. (i) Show that, the number of undecayed radioactive nuclei (N) of a sample at time(t)is $N(t) = N_0 e^{-\lambda t}$, where, N_0 is the number of undecayed nuclei at a time $t = 0$ and λ is decay constant.
(ii) In a radioactive sample number of undecayed nuclei decreases from 16000 to 1000 in 12 days. Find the half-life anddecay constant.
(iii) Define isotope with an example.

5+4+1 = 10

ALIAH UNIVERSITY

Odd (Autumn) Examination 2024
Elementary Arabic and Islamic Studies
Course Code: UCCUGAU01

Full Marks: 80 Time: 3:00Hrs.

ARABIC

Q. 1. Attempt any ten questions, each question carries equal marks. 2x10=20

i. Merge the following letters and make them words: م+ص+ي+ط+ر ، م+ه+ي+م+ن
ii. Identify the letters of the following words and Split them: مشفقين، يعملون
iii. Read the following words and write the pronunciation in English: لَأُعَذِّبَنَّهُمْ، فَلَنَسْأَلَنَّ
iv. Identify the following words as they are of 'Noun' (اسم) or 'Verb' (فعل) :
حَامِد، سَوْفَ يَذهب، الجَامِعَةُ، قَدْ جلس
v. Change the Gender of following words: صالح بيضاء، مدرس، ممرضة،
vi. Identify the following words either definite (المعرفة) or indefinite (النكرة) :
الجدار حكيمٌ يَا مالك رحيمٌ
vii. Write down the Examples of Huruf (الحروف) from parts of speech.
viii. Write any four demonstrative Pronouns (اسم الإشارة) of Arabic.
ix. How many kinds of sentences are there in Arabic?
x. How many kinds of Madd are in Arabic? And what are they?
xi. What do you Know about Shaddah ? write in short with example.
xii. Change the Nominal sentence into verbal sentence and Verbal sentence into Nominal Sentence. الأُسْتَاذُ ذَهَبَ إِلى الْمَدْرَسَةِ دَخَلَتْ البِنْتُ فِي الفَصْلِ

Q. 2. Attempt any two questions, each of them carries equal marks. 10×2=20

i. Write the Arabic numbers 1-10 in Arabic scripts.
ii. Write about Parts of Speech in Arabic in details by citing of examples.
iii. Write down the Moon Letters (الحروف القمرية) and Sun Letters (الحروف الشمسية) in Arabic.

Islamic Studies

Answer any four Questions: 10x4=40

1. What is Tawheed? Define its types with example.
2. Write a short note about the life Prophet Muhammad (PBUH). Who is the first and last Nabi in the Islamic History?
3. What is 'Alam-e Akherat' ? Write a brief essay on it.
4. What do You Know about Zakat? To whom Zakat is Farz? Write a short note on it.
5. What is Namaz? How many times the Namaz should perform?
6. How many types of Hajj are there? Discuss brief by to whom this Hajj is Farz?

ALIAH UNIVERSITY
END TERM EXAMINATION, AUTUMN 2024
PAPER: MATUGBS01 (Engineering Mathematics I)
Full Marks: 80
Time Allowed: 3 Hours
All symbols have their usual meanings
Use different answer script for different group

GROUP - A (40 marks)

Answer any **EIGHT** of the following questions: $5 \times 8 = 40$

1. Define a bounded sequence of real number? Define a monotone sequence of real number? Using definition show that the sequence $\{a_n\}$ where $a_n = \frac{1}{n^2} + 5$ is bounded and monotone both. $1 + 1 + 3$

2. Define a convergent and a divergent sequence of real number. Check whether the sequence $\{x_n\}$ is convergent or divergent, where $2 + 3$

$$x_n = \frac{1}{1 \cdot 2} + \frac{1}{2 \cdot 3} + \frac{1}{3 \cdot 4} + \cdots + \frac{1}{n(n+1)}.$$

3. Show that $\lim_{n \to \infty} x^{\frac{1}{n}} = 1$, for $x > 0$. 5

4. Define interval of convergence for a power series? Prove the Geometric series $\sum x^n$ is convergent if $-1 < x < 1$, divergent if $x \geq 1$ and is oscillatory if $x \leq -1$. $1 + 4$

5. Test the convergence of the series 5

$$\frac{4}{1.3.5} + \frac{6}{3.5.7} + \frac{8}{5.7.9} + \cdots$$

6. State the D'Alembert's Ratio test. Using D'Alembert's Ratio test prove that the series

$$\frac{1^2}{3} + \frac{2^2}{3^2} + \frac{3^2}{3^3} + \frac{4^2}{3^4} + \cdots$$

is convergent. $1 + 4$

7. Show that the function 5

$$f(x) = |x| + |x - 1| + |x - 2|$$

continuous at the points $x = 0, 1, 2$.

8. Define Global maximum and Global minimum for a function $f(x)$?
Prove that the function $f(x) = x^3 - 9x^2 + 24x - 12$ has a global maximum and a global minimum, also find the global maximum and minimum values of $f(x)$. $1 + 4$

9. Let $f : [a, b] \to \mathbb{R}$ be a differentiable function on (a, b).

   (a) If $f'(x) < 0$ in (a, b), then by using mean value theorem prove that $f(x)$ is monotonically decreasing in (a, b). $2\frac{1}{2}$

   (b) If $f'(x) > 0$ in (a, b), then by using mean value theorem prove that $f(x)$ is monotonically increasing in (a, b). $2\frac{1}{2}$

10. State the Taylor's theorem. Expand $\cos x$ in a finite series in Lagrange's form of remainder. $2 + 3$

11. Using L' Hospital rule evaluate $\lim_{x \to \infty} \left(\frac{\sin x}{x}\right)^{\frac{1}{x}}$. 5

12. If m is a positive integer then show that 5

$$\beta(m, n) = \frac{(m-1)!}{n(n+1)(n+2)\cdots(n+m-1)}.$$

GROUP - B (40 marks)

Answer any **EIGHT** of the following question: $5 \times 8 = 40$

1. (a) If a line makes an angle $\frac{\pi}{3}$ with x-axis, $\frac{\pi}{4}$ with y-axis and $\theta \in (0, \pi)$ with z-axis, then find the value of θ. 3

   (b) Convert the point $(-7, -7\sqrt{3})$ to the polar coordinate. 2

2. Find the distance between the lines 5

$$\frac{x-0}{1} = \frac{y-1}{0} = \frac{z-1}{1} \quad \text{and} \quad \frac{x-1}{1} = \frac{y-1}{1} = \frac{z-1}{1}$$

3. Find the equation of the plane passing through the point $(1, -1, 2)$ and perpendicular to the planes $2x + 3y - 2z = 5$ and $x + 2y - 3z = 8$. 5

4. Show that the four points $(0, -1, -1), (4, 5, 1), (3, 9, 4)$ and $(-4, 4, 4)$ lie on a plane. Also write down the equation of the plane. 5

5. Find the nature of the quadric surfaces and hence evaluate its volume.

   (a) $3x^2 + 5y^2 + 3z^2 - 12x + 20y - 6z = 5$. 3

   (b) $3x^2 + 3y^2 + 3z^2 - 6x - 6y + 6z = 18$. 2

6. Find the curvature of the curve 5

$$F(t) = (3\cos t,\ 2t,\ 3\sin t).$$

7. Find the torsion of the curve 5

$$F(t) = (t^2,\ 2,\ t^3).$$

8. Evaluate

$$\iint dxdy$$

over the region bounded by $y = x^2$ and $x = y^2$. 5

9. Evaluate

$$\iint (x^2 + y^2)\, dxdy$$

over the region bounded by $xy = 1$ $y = 0, y = x$ and $x = 2$. 5

10. Evaluate

$$\iiint (x + y + z + 1)dxdydz$$

over the region defined by $x \geq 0,\ y \geq 0,\ z \geq 0,\ x + y + z \leq 1$. 5

11. Use Green's Theorem to evaluate

$$\oint_C (xydx + x^2y^3dy)$$

where C is the triangle with vertices $(0, 0), (1, 0), (1, 2)$ with positive orientation. 5

12. Use Divergence Theorem to evaluate

$$\iint_S \vec{F} \cdot d\vec{S}$$

where $\vec{F} = \sin(\pi x)\hat{i} + xy^3\hat{j} + (z^2 + 4x)\hat{k}$ and S is the surface of the box with $-1 \leq x \leq 2, 0 \leq y \leq 1$ and $1 \leq z \leq 4$. 5

1ST SEMESTER B. TECH (MECHANICAL ENGINEERING)

END SEMESTER EXAMINATION, JANUARY-2024

ENGINEERING MECHANICS- MENUGES01

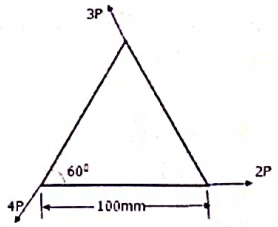
Full Marks = 80 **Time – 3 hours**

(Assume missing data if any)

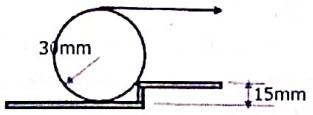
Group- A.

(Answer any five questions) **[5x (3+5) =40]**

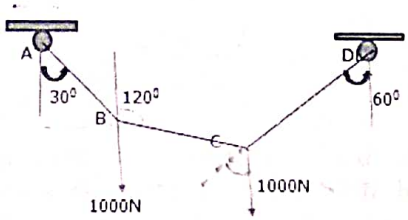
1. (a) State the Varigon's Principle of moments.
   (b) Three forces of 2P, 3P & 4P act along the sides of an equilateral triangle of side 100mm taken in order. Find the magnitude and position of the resultant force.



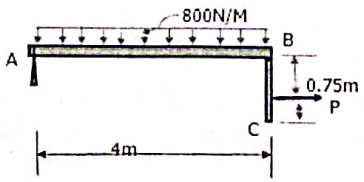
2. (a) State Lami's theorem.
   (b) A roller of radius 30mm and weight 1000N is to be pulled over a curb of height 15mm by a horizontal force 'P' applied to end of a string wound round the circumference of the roller as shown. What will be the magnitude of force 'P' required to start the roller over the curb?



3. (a) What is free body diagram.
   (b) A string ABCD, attached to fixed points A and D has two equal weights of 1000N attached to it at B and C. The weights rest with the portions AB and CD inclined at an angles as shown below. Find the portions AB, BC andCD of the string, if the inclination of the portion BC with the vertical is 120°.

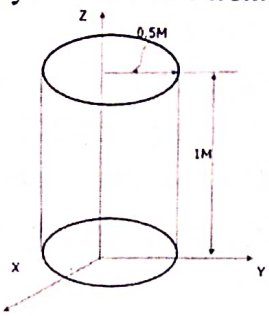


4. (a) What is angle of repose and angle of friction? Establish relation between them.
   (b) Beam AB is subjected to a uniform load 200N/m and is supported by at B by post BC as shown in Figure. If the co-efficient of static friction at B and C are μ_B 0.2 and μ_C0.5, determine the force P needed to pull the post out from the under the beam. Neglect the weight of members and thickness of the beam.



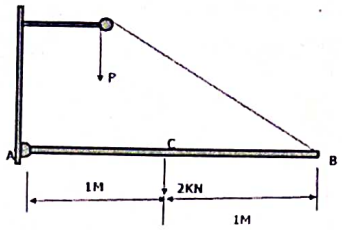
5. (a) Define centroid, center of mass and center of gravity? In a composite body will the centre of mass and centroid in same position?

(b) Determine the location of the center of mass moment of area of the cylinder shown in figure if it is having density which varies directly with distance from its base i.e, ρ 200Kg/m^3.



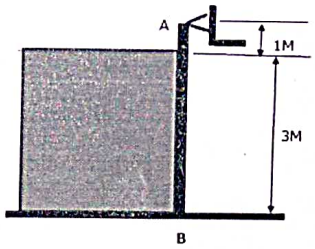
6 (a) What are applications of virtual work? State the principle of virtual work.

(b) A beam AB of 2m length is held in equilibrium by the application of a force P as shown in Figure given below. At mid-point C, of ABa weight of 2KN is acting vertically downward. Find the magnitude of the force **P**.



7. (a) Define Torsion, normal stress and strain. What is the relation between stress and strain? Is there any shear forces acting in a static fluid?

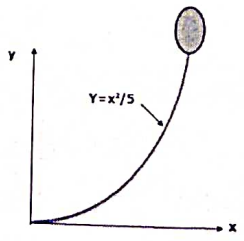
(b) A rectangular plate, shown in vertical section AB, is 4m high and 6m wide (normal to the plane of paper) and blocks the end of a fresh water channel 3m deep. The plate is hinged about a horizontal axis along its upper edge through A and is restrained from opening by the fixed ridge B which bears horizontally against the lower edge of the plate. Find the force at B exerted on the plate by the ridge.



8. At any instant the horizontal position of weather balloon in figure is defined by $x = (2t)$ m, where t is in second. If the equation of the path is $y = x^2/5$, determine the magnitude and direction of

(i) The velocity and (ii) acceleration when t= 2 sec.

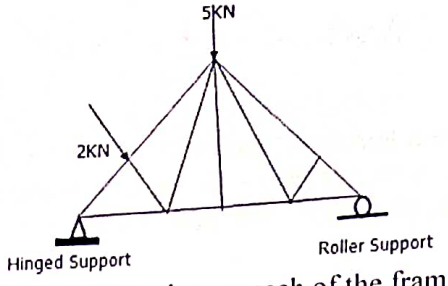
(ii) Acceleration when t= 2 sec.



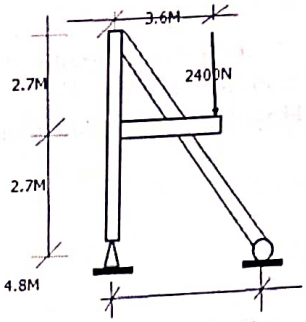
Group - B

(Answer <u>any four</u> questions only) ***[4x (10) =40]***

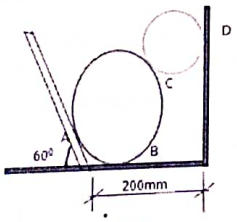
1. (a) Using the method of joints, determine all zero force members of the Fink Roof Truss shown below. [5]



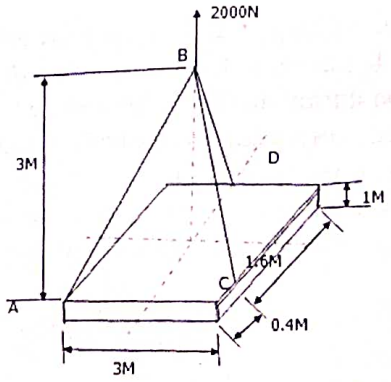
(b)Determine the component of the forces acting on each of the frame shown in figure. [5]



2. Two smooth cylinders each of weight 2000N and 800N respectively rest on a horizontal channel having one inclined angle and one vertical wall as shown in the figure. The radius of bigger cylinder is 100mm while that of smaller cylinder is 50mm. The angle between inclined wall with horizontal is 60^0. Find the pressure exerted on the walls and floors at point of contact A, B, C & D. [10]

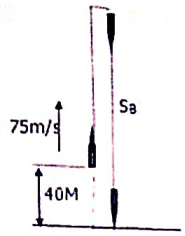


3. A crane (Not Shown in Fig) is supporting a 2000N crate through three cables AB, CB and DB. Note that D is at the centre of the outer edge and B is directly above the centre of the crate. What are the forces F1, F2 and F3 transmitted by the cables? [10]

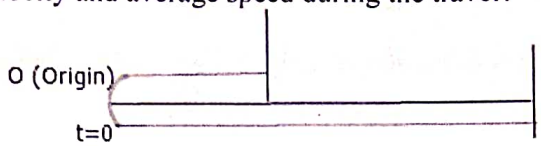


4. (a) During a test rocket travels upward at 75 m/s and when it is 40m from the ground its engine fails. Determine the maximum height S_B reached by the rocket and its speed just before it hits

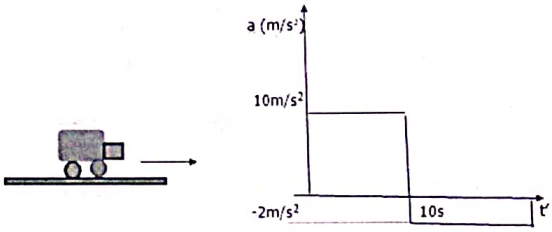
the ground, while in motion the rocket is subjected to a constant downward acceleration of 9.81 m/s2 due to gravity. Neglect the effect of air resistance. [5]



(b)A Particle moves along a horizontal path with a velocity, $v=3(t^2-6t)$ m/s, where "t" is the time in sec. If it is initially located at the origin O, determine the distance travelled in 3.5 sec and the particle average velocity and average speed during the travel? [5]

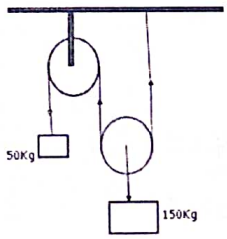


5. The car in figure starts from rest and travels along a straight track such that it accelerates at $10m/s^2$ for first 10sec and then decelerates at $2m/s^2$. Draw the s-t and v-t graphs and determine the time "t" needed to stop the car. How far has the car travelled? [10]



6. (a) A ball is projected from a point with a velocity of 10m/s on an inclined plane. The angle of projection and inclination of the plane are 35^0 and 15^0 respectively with the horizontal. Find the time of flight of the ball, when it is projected upwards and downwards the plane. [5]

(b) Determine the tension in the strings and accelerations of two blocks of mass 150Kg and 50kg connected by a string and a frictionless and weightless pulley as shown in figure [5]



7. (a) An elevator of mass 3000kg is moving downward vertically with a constant acceleration starting from the rest. It travels a distance of 40m during travel in interval of 10sec. Find the cable tension in Newton during this time. Assume, $g=10m/s^2$. [5]

(b) A trailer is travelling down with 2^0 inclination with horizon (shown in figure) at a speed of 25m/s, when the brakes are applied. Knowing the static and kinetic coefficient of frictions between the loads and flatbed trailer shown are 0.4 and 0.35 respectively. Determine the shortest time in which the trailer brought to a stop if the load is not to shift. [5]

