Applied Mathematics-I
Revised Course (NEP-2020)
(Dec 2024)

Marks-60
Durations-02 Hours

Question 1 is compulsory.
Attempt any 3 from questions 2 to 6.
Scientific Calculator is allowed to use.

1. Attempt any **Five** questions. **(Compulsory Problem)**

   (a) Find all values of $(1+i)^{1/3}$.

   (b) Prove that: $tanh(log\sqrt{3}) = 0.5$

   (c) If $u = (1 - 2xy + y^2)^{-1/2}$, prove that $x\frac{\partial u}{\partial x} - y\frac{\partial u}{\partial y} = y^2 u^3$.

   (d) Find n^{th} derivative of $y = e^{ax} \sin^2 x$.

   (e) Show that the matrix $A = \frac{1}{\sqrt{3}}\begin{bmatrix} 1 & 1+i \\ 1-i & -1 \end{bmatrix}$ is unitary and hence find A^{-1}.

   (f) Using Newton Raphson's Method, find an iterative formula for $\sqrt[3]{150}$.

2. (a) If $H = f(y - z, z - x, x - y)$, then prove that $\frac{\partial H}{\partial x} + \frac{\partial H}{\partial y} + \frac{\partial H}{\partial z} = 0$.

   (b) Prove that $log(e^{i\alpha} + e^{i\beta}) = log\left[2 cos\left(\frac{\alpha-\beta}{2}\right)\right] + i\left(\frac{\alpha+\beta}{2}\right)$.

   (c) Apply the Gauss Seidel method, to solve the following system of linear equations up to the two iterations.
   $15x + 3y - 2z = 85, \ x - 2y + 8z = 5, 2x + 10y + z = 51$.

3. (a) Discuss the maxima and minima of $(x^2 + y^2 + 8x + 6y + 6)$.

   (b) Solve the equation $x^4 + x^3 + x^2 + x + 1 = 0$.

   (c) If $u = \sin^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$, then prove that $x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x\partial y} + y^2\frac{\partial^2 u}{\partial x^2} = -\frac{\sin u \ \cos 2u}{4\cos^3 u}$.

4. (a) Prove that $sech^{-1}(\sin\theta) = log\left(cot\frac{\theta}{2}\right)$.

   (b) Prove that $cos^6\theta = \frac{1}{32}(cos6\theta + 6cos4\theta + 15cos2\theta + 10)$.

   (c) Find nonsingular matrices P & Q such that PAQ is in normal form and hence find rank of the matrix A for the
   following matrix $A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$.

5. (a) Find a, b, c & A^{-1} if $A = \frac{1}{9}\begin{bmatrix} 8 & -4 & a \\ 1 & 4 & b \\ 4 & 7 & c \end{bmatrix}$ is orthogonal.

   (b) State & prove Euler's theorem on homogeneous functions with two independent variables.

   (c) If $y = e^{tan^{-1}x}$ then prove that $(1 + x^2)y_{n+2} + [2(n+1)x - 1]y_{n+1} + n(n+1)y_n = 0$.

6. (a) Find n^{th} derivative of $y = \frac{x}{1+3x+2x^2}$.

   (b) Investigate for what values of λ and μ the system of linear equations $x + y + z = 6; x + 2y + 3z = 10;$
   $x + 2y + \lambda z = \mu$ will have (i) No solution, (ii) Unique solution, (iii) Infinite number of solutions.

   (c) Find the three sets of iterative solutions of the following equations by Gauss Jacobi method:
   $5x - y + z = 10; 2x + 4y = 12; x + y + 5z = -1$.

FE Sem -I All Branches NEP 2020

Time: 1.30 Hours **Marks: 45**

N.B.
1. Question number 1 is compulsory.
2. Attempt any two questions from Q.2 to Q.5.
3. Draw neat diagrams and write chemical equations wherever necessary.
4. Figures to right indicate full marks.

1. Solve any Five
(a) What are the characteristics of good fuel? — 3
(b) Define corrosion, how you will join the metals to prevent corrosion, justify with diagram. — 3
(c) Give the purposes of making of an alloy. — 3
(d) Explain the term 'glass transition temperature' with significance. — 3
(e) Define Matrix phase and dispersed phase with example. — 3
(f) Write are the principles of Green Chemistry. — 3
(g) 0.5 gm. of coal sample was burnt in Bomb calorimeter produced 0.06 gm. of $BaSO_4$, calculate percentage of sulphur — 3

2. (a) What is cathodic protection? How is it done by using impressed current and sacrificial anode? Explain with suitable examples. — 6
(b) Explain with neat suitable diagram determination of Carbon and hydrogen. by ultimate analysis — 5
(c) What do you mean by green solvent, explain it with suitable example. — 4

3. (a) A Polymer has the following composition: 100 Molecules of molecular mass 1000, 200 molecules of molecular mass 2000 and 500 molecules of molecular mass 5000. Calculate the number and weight average of molecular weight and the polydispersity index. (PI) — 6
(b) What is condensed phase rule equation? Explain its application with the help of phase diagram to two component lead-silver system. — 5
(c) Explain Laminar and sandwich panel of structural composite. — 4

4. (a) Explain following properties of polymer a) Electrical b) Optical. — 6
(b) Explain synthesis of Indigo dye by traditional way and by green pathway. — 5
(c) A sample of coal has the following composition C = 80 %, O = 8%, H = 6 %, S = 1.5%, N = 1 %, Calculate the higher and lower calorific values of coal. — 4

5. (a) Explain the effect of following factors on the rate of corrosion : — 6
   (1) Nature of corrosion product.   (2) pH
   (3) Anodic and cathodic areas   (4) purity of metal

(b) Explain a) Fiber glass reinforced composite.
            b) Carbon fiber reinforced composite. — 5

(c) An alloy of tin and lead contain 73% tin. Find the mass of eutectic in 1kg of solid Alloy, if the eutectic contains 64% of tin. — 4

QP code: 10070779

FE Sem-I All Branches NEP 2020

19/12/2024

[Max Marks:45]

Duration: 1 ½ hours

N.B. : (1) Question No 1 is Compulsory.

(2) Attempt any two questions out of the remaining four.

(3) Assume suitable data, if required and state it clearly.

1   Attempt any FIVE   [15]

(a) What is metastable state? What is the role of metastable state in LASER?

(b) An optical fiber has an acceptance angle of 30° and core refractive index of calculate refractive index of cladding?

(c) Explain why an excessively thin film appears black in reflected light?

(d) Show that the divergence of a curl of a vector is zero.

(e) State the properties of matter waves.

(f) An electron is bound in an 1D potential well of width 2 A° but of infinite height. Find its energy values in the ground state and in first excited state. (Given: Planck constant is 6.634×10^{-34} J-Sec)

(g) Write Fermi Dirac distribution function and explain the terms involved in it

2 (a) With the neat energy level diagram, explain the construction and working of He Ne Gas laser.   [05]

(b) Derive an expression for numerical aperture of a step index optical fiber.   [05]

(c) In a Newton's ring arrangement, a drop of liquid of refractive index 1.33 is placed in between the lens and plate. The diameter of 9th dark ring is found to be 0.58 cm. Obtain the radius of curvature, if the wavelength of light is 6000 A°.   [05]

3 (a) What is gradient? If $\emptyset = 3(x^2y - y^2x)$, find $\nabla\emptyset$ at the point (1, -2,-1).   [05]

(b) Prove that electron cannot reside inside the nucleus of an atom.   [05]

(c) Predict the effect on the electrical properties of a silicon at room temperature if every millionth silicon atom is replaced by an atom of indium.   [05]

Given: Concentration of silicon atoms are 5×10^{28} /m^3

intrinsic conductivity of silicon is 4.4×10^{-4} /Ω-m

mobility of holes is 0.048 m^2 / volt-sec.

4 (a) Show that for an intrinsic semiconductor, fermi level lies midway of conduction band and valence band. [05]

(b) With the experimental set up of Newton's ring, explain the determination of refractive index of a liquid. [05]

(c) An electron and a photon each have a wavelength of 2A°. What are their momentum and energies? [05]

5 (a) Compare Step Index fiber and Graded Index Fiber. [05]

(b) State and explain Maxwell's fourth equation. [05]

(c) What is Lidar technology and how does it work? [05]

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01|01| 2025

Time: 2 Hrs   **Max. Marks: 60**

N. B.   (1) Question No.1 is compulsory.
(2) Attempt any 3 questions from remaining five questions.
(3) Assume suitable data if necessary and mention the same clearly.
(4) Take g = 9.81 m/s^2, unless otherwise specified.

Q1.   **Solve any Five**   (03)
a)   For the system shown, determine:
(i) The required value of α, and if resultant of three forces is to be vertical.
(ii) The corresponding magnitude and direction of the resultant.
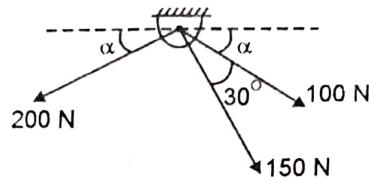
b)   A cylinder having a 25 kg mass is suspended as shown in fig. Calculate the tension in the
string and the reaction from the slope.   (03)
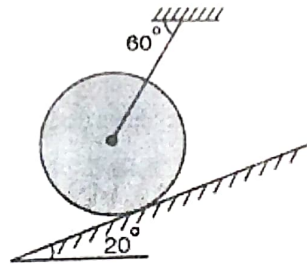
c)   A wooden block of 100 N weight rests on a horizontal plane as shown in figure.
Determine the force P required to just impend the motion. For the surface μs = 0.4 & μk
= 0.25.   (03)
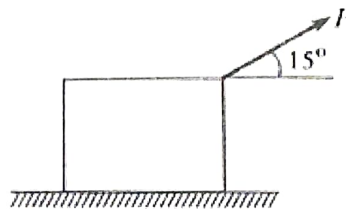
d)   A force acts at the origin in the direction defined by the angles θ$_y$ = 65^0 & θ$_z$ = 40^0.
Knowing that the x-component of the force is 750 N. Determine (i) the value of θx (ii)
other components. (iii) Magnitude of the force.   (03)

e)   The car moves in a straight line such that for a short time its velocity is defined by
v = (9t^2 + 2t) m/s. where t is in seconds. Determine the position and acceleration when
t = 3 sec.
(03)

f)   Explain The following with neat sketches   (03)
i) Direct central impact ii) Oblique central impact.

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Q 2 A) Find the coordinate of the centroid for the shaded part of the lamina with respect to given reference axis. (07)
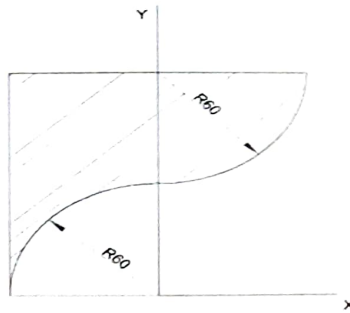
B) A particle follows the path $y = 5 + 0.3x^2$, At certain instant when x = 2m, its speed is 10 m/s and increasing at the rate of 0.5 m/s^2. Determine the components of velocity and total acceleration of the particle, when x = 2. (08)

Q 3 A) Following figure shows the four forces and one couple which act on the plate shown. Find the resultant force and locate its position from point 'O' (07)
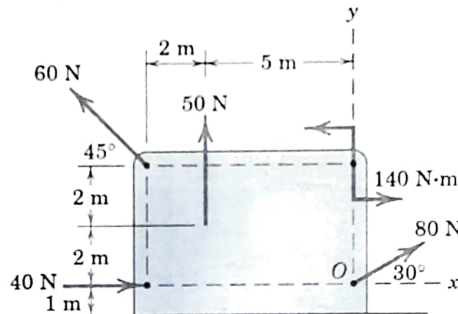
B) When the mechanism is in the position shown, the angular velocity of bar AB is 3 rad/s clockwise. Using instantaneous center of rotation, calculate the angular velocity of bar BC and the velocity of slider C for this position. (08)
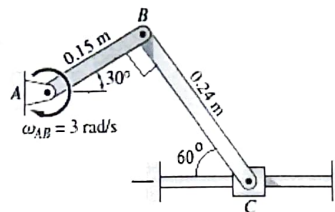
Q 4. A) Two identical rollers each of mass 50 kg are supported by an inclined plane and a vertical wall as shown in fig. Assuming smooth surfaces, find the reactions induced at the point of support A, B and C. (07)

XΛ03YD3EC75YΛ03YD3EC75YΛ03YD3EC75YΛ03YD3EC75YΛ03YD3EC75
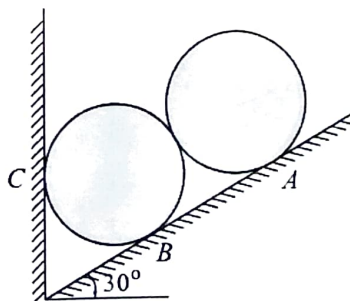
B) In the figure shown, the two blocks are originally at rest. Neglecting the masses of the pulleys and considering the coefficient of friction between the block A and inclined plane as 0.25, determine (i) the acceleration of each block and (ii) the tension in the cable. W_A= 8N, W_B = 16 N. (08)
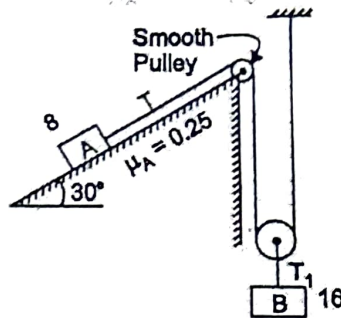
Q 5. A) A block of weight 800 N is acted upon by a horizontal force P as shown in fig. Knowing that the coefficient of friction between the block & the incline are μ_s = 0.35, μ_k = 0.25. Determine the range of force P required to keep the block in equilibrium. (07)
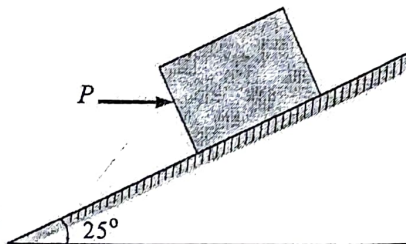
B) A block of 50 kg resting on a horizontal surface is acted upon by a horizontal force P which varies as shown in figure, If the coefficient of friction between the block & surface is 0.2. Find velocity of block at t = 5sec & t = 10 sec Also determine time when the block will come to rest. At t=0, V=0 (08)
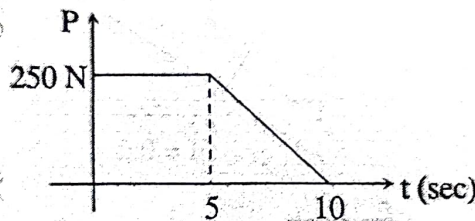
Q 6.A) Classify Robot Mechanics and explain main parts of a robotic arm with neat sketch. (07)

B) For the beam loaded as shown in figure, Calculate the support reactions at A and B. (08)

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FE Sem-I All Branches NEP-2020

03/01/2025
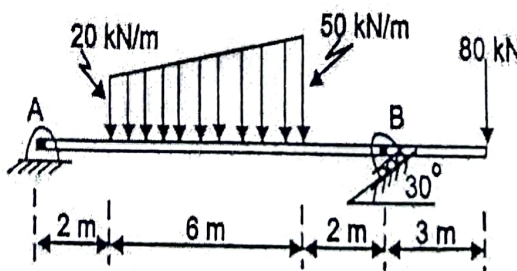
Time: 2 Hours   **Max Marks: 60**

N.B.:   (1) Question No.1 is compulsory.

(2) Attempt any THREE questions from remaining FIVE questions.

(3) Assume suitable data if necessary and mention the same clearly.

(4) Figures on the right indicate the marks.

			Marks
Q.1	a.	Write formulas for Delta to Star and Star to Delta transformation.	3
	b.	An alternating current of frequency 50 Hz has a maximum value of 12 A. Find (i) Equation for instantaneous value of current and (ii) Time taken to reach 9.6 A for the first time.	3
	c.	What is the efficiency of transformer?	3
	d.	State the function of each constructional part of a DC motor.	3
	e.	Write applications of LED.	3

Q.2 a. Using Superposition theorem, find voltage across 4 Ω resistor.   10

   b. Explain the working principle of three phase induction motor.   5

Q.3 a. A coil consumes 1 KW power from 50 Hz single phase ac supply and   10
volt-ampere input is 2 KVA. If value of resistance of coil is 10 Ω then find
the following parameters with respect to a coil.
(i)Value of inductance, (ii) Phase angle, (iii) Power factor, (iv) Impedance,
(v) Voltage and Current equations, (vi) KVAR

   b. Draw and explain the V-I characteristics of a Zener diode   5

Q.4 a. State and prove the Maximum power transfer theorem. Derive the formula   5
of Maximum power delivered.

   b. Explain the application of BJT as an amplifier.   5

   c. Three similar coils each having a resistance of 5 Ω and an inductance of   5
0.02 H are connected in star to a 440 V, 50 Hz, 3-phase supply. Calculate
(i) line current and (ii) active and reactive power

Q.5 a.   Explain the working principle and transformation ratio of a single-phase   6
           transformer.

     b.   Write short note on any one: 4
          (i)Single phase induction motor
          (ii)BLDC motor.

     c.   Two impedances of $12 + j16$ Ω and $10 - j20$ Ω are connected in parallel   5
          across 230 V, 50 Hz, single phase ac supply. Find admittance, current and
          power factor of each branch.

Q.6 a.   Find current flowing through 1Ω resistance by Node analysis.   6
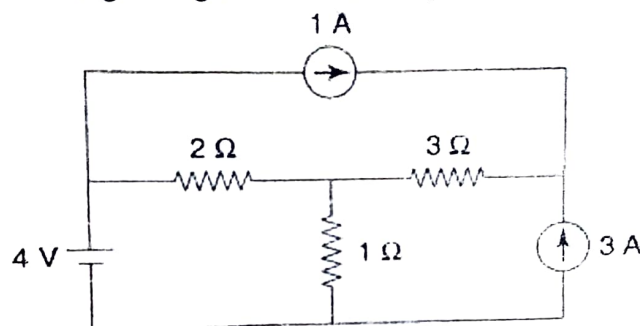
     b.   State the necessary condition for resonance in a series circuit. Compare   5
          series and parallel resonance.

     c.   Write a short note on FET.   4

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FE Sem-I All Branches NEP-2020
06|01|2024

Time: 1 ½ Hours   **Total Marks: 45**

N.B.: 1. Q.1. is compulsory.
2. Attempt any two out of the remaining four questions.
3. Figures to the right indicate full marks.
4. Answers to the sub questions should be grouped together.
5. Assume suitable data wherever necessary.

Q.1 Answer the following questions: **(15)**
1. Explain in brief any five postulates of communication.   **(05)**
2. Enlist steps in writing user instruction.   **(05)**
3. Define Intensive and Extensive reading Methods.   **(02)**
4. Provide diagrammatic representation & explanation of the full block form/style. **(03)**

Q.2. Answer any three of the following questions: **(15)**
a) Identify type/s of Communication Barriers in the following communication events.
   (1 Mark each)   **(05)**
   i) Payal accidently factory reset her android phone. She could not access her files and folders.
   ii) Due to shyness and extreme fear, Shaan avoids any interaction with strangers.
   iii) Due to temporary vision loss, David was not able to read the given instruction.
   iv) The natives and the migrants conflict affected business relationship & harmony.
   v) Ravi couldn't interpret Pavan's cues as Pavan was communicating through codes.

b) Identify the organizational communication network in the following communication events. **(1 Mark each)**   **(05)**
   i. The Chief administrative officer issued a memo to all the administrative staff.
   ii. The students submitted the required documents to the institute.
   iii. All Class representatives discussed the plan for conducting inter class quiz competition.
   iv. The employee submitted his/her leave application to the office administration.
   v. Rajan forwarded fake holiday message to all his classmates.

c) State whether the following Statements are true or false. **(1 Mark each)**   **(05)**
   i. Non-Verbal Communication is ambiguous in nature.
   ii. No feedback is also feedback.
   iii. Haptics is science of studying how people perceive and use space in communication acts.
   iv. Physical disability and diseases are types of psychological communication barriers.
   v. The grapevine communication is a formal communication network.

d) Match the following: **(05)**

Flow Chart	Principle of writing
Courtesy	Reading Comprehension Method
Olfactory	Graphic organizer (GO)
Resistance to change	Sense of smell
Skimming	Communication barrier
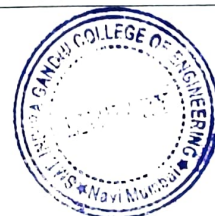
Q.3 Answer any three of the following questions: (15)

A. Write a request letter to the Principal of your institute for requesting his/her permission for organizing a 'Technical Writing Workshop' for the institutional students. (Use the Full Block Form) (05)

B. You purchased a Wi-Fi router from Sampark Infotech, Bandra (West) Mumbai 400050 Via online mode. The shop delivered your order promptly. On opening the package, you observed that the shop sold you a damaged router. You cannot use the dead router. Write a Complaint cum Claim for Compensation letter to the Sales Manager of the shop. (Use the Full Block) (05)

C. Write Instruction for filling and submitting the offline exam form. (05)

D. Describe a Mini drafter. (05)

Q.4 Answer any three of the following questions: (15)

a) Write whether the following statements are Note, caution, Warning, Danger.
(1 Mark each) (05)
   1. Password is case sensitive
   2. Be careful. The floor is wet.
   3. Trespassers will be prosecuted
   4. Highly inflammable material
   5. No Entry: Risk of Electrical Hazards

b) Summarize the given texts in one sentence (retain the central idea/message) (05)

I. Hackathon competitions are time-limited events where participants, typically software developers, designers, and problem solvers, collaborate to create innovative solutions to specific challenges. These competitions encourage creativity, teamwork, and problem-solving skills, often in the form of software applications, websites, or new technology prototypes. Hackathons can range from local events to global contests and are commonly hosted by tech companies, universities, or organizations aiming to foster innovation and discover new talent. (02)

II. The Fit India Movement is an initiative launched by the Government of India in 2019 to inspire and encourage citizens to prioritize physical fitness and well-being. Its goal is to raise awareness about the importance of a healthy lifestyle, reduce sedentary habits, and promote physical activity across all age groups. The campaign includes activities like yoga sessions, fitness challenges, and programs aimed at schools, colleges, and workplaces to foster a culture of fitness nationwide. (02)

III. Internshala is an online platform that connects students with internships across various industries. It offers a wide range of opportunities, from remote internships to those in fields like engineering, marketing, content writing, design, and more. Internshala helps students gain practical experience, develop skills, and enhance their resumes, making them more competitive in the job market. The platform also provides training programs to help students improve their skills before applying for internships. (01)

c) Enlist Seven Cs of communication. Write one sentence explanation of each 'C' (05)

d) Enlist Smart Goals System components. Write one sentence explanation of each component. (05)

Q.5 Read the following text and answer the questions given below: (15)

Plagiarism is indeed the greatest evil in the intellectual world. It is a type of intellectual theft in which one presents other person's thoughts and ideas as if one's own. The concept of plagiarism is taken from the Latin word 'Plagiarius' which means 'abductor or kidnapper'. The academia, industry and research communities are affected by the intentional and unintentional acts of plagiarism. Plagiarism can take various forms, each involving the unauthorized use of someone else's work or ideas. Direct plagiarism involves copying another person's work word-for-word without citation. Self-plagiarism occurs when an individual reuses their own previously published work without acknowledgment. Mosaic plagiarism involves piecing together phrases, ideas, or passages from different sources and presenting them as original. Accidental plagiarism happens when proper citation is overlooked or when someone unintentionally uses someone else's ideas without giving credit. Lastly, paraphrasing plagiarism is when someone rewrites someone else's work in their own words without proper citation, essentially still taking credit for the ideas.

The practice of plagiarism has become very common in the era of 'Information Technology'. The advancements in IT and ICT technologies have brought revolutionary changes in education and research. The rise of AI enabled tools are acting as a big support for students, academicians and researchers. However, the misuse of these highly equipped tech tools is worsening the issue of plagiarism.

Considering the gravity of the situation, the academic and research regulatory bodies are framing appropriate policies and adopting the adequate measures for curbing the menace of plagiarism. These regulatory bodies are planning to initiate penal action against the plagiarism in academics and research. Even if there are numerous legal provisions to punish the plagiarizers, yet no legal aid can control the practice of plagiarism completely. The strict adherence to academic and research ethics as well as the professional code of conduct might solve the issue of plagiarism. Everyone should abide by the relevant rules and regulations and everyone should practice personal and professional ethics for avoiding academic and research malpractices. One's strong commitment to personal professional ethics and respect for one's and other's Intellectual Property Rights might curb the issue of plagiarism.

1. Define Plagiarism. What is Direct plagiarism? (03)
2. Explain self-plagiarism and Mosaic plagiarism. (03)
3. Describe how the academic and research regulatory bodies are dealing with plagiarism issue. (03)
4. How can we curb the menace of Plagiarism? (03)
5. What is meaning of Plagiarius? (01)
6. Explain paraphrasing plagiarism. (02)

QPcode: 10066928

FE Sem-I R-19 C Scheme All branches
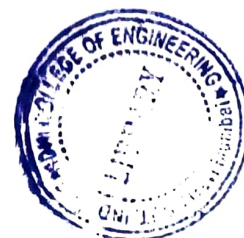
| Time: 3 Hours | Max. Marks: 80 |

N. B. (1) Question No.1 is compulsory.

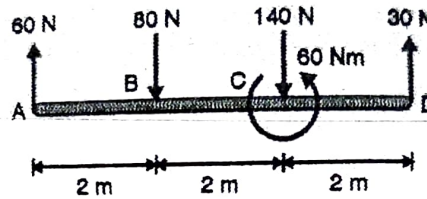(2) Attempt any 3 questions from remaining five questions.

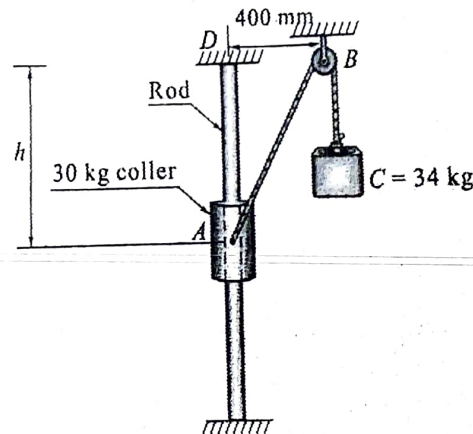(3) Assume suitable data if necessary and mention the same clearly.

(4) Take g = 9.81 m/s², unless otherwise specified.

Q1. Solve any Four-

a) Replace the given force system in two parallel components at B & D. (05)

b) The 30 kg collar may slide on frictionless vertical rod and is connected to a 34 kg counterweight. Find the value of h for which the system is in equilibrium. (05)

c) A block rests on a rough inclined plane making an angle of 30⁰ with the horizontal. The coefficient of static friction between the block and the plane is 0.8. If the frictional force on the block is 10 N, Find the mass of the block (in kg). (05)

d) A force acts at the origin in the direction defined by the angles $\theta_y = 65^0$ & $\theta_z = 40^0$. Knowing that the x-component of the force is 750 N. Determine (i) the other components. (ii) Magnitude of the force & (iii) the value of θx. (05)

e) Explain the following with example- (05)
   i) General Plane motion.
   ii) Instantaneous centre of rotation.

f) If x = 1- t and y = t² where x and y are in meters and t is in second, determine the acceleration of the particle at t= 3 sec. (05)
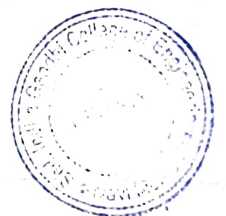
Q 2
A) Two spheres A and B of weight 1000 N and 750 N respectively are kept as shown in figure. Determine the reactions at all contact points 1,2, 3 and 4. Radius of A is 400 mm and radius of B is 300 mm   (07)
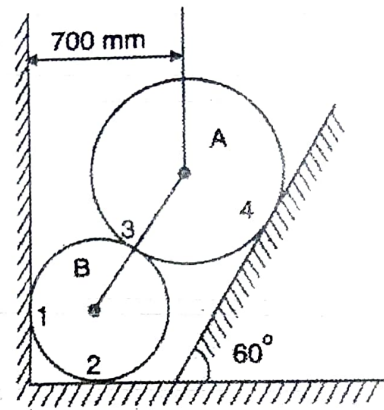
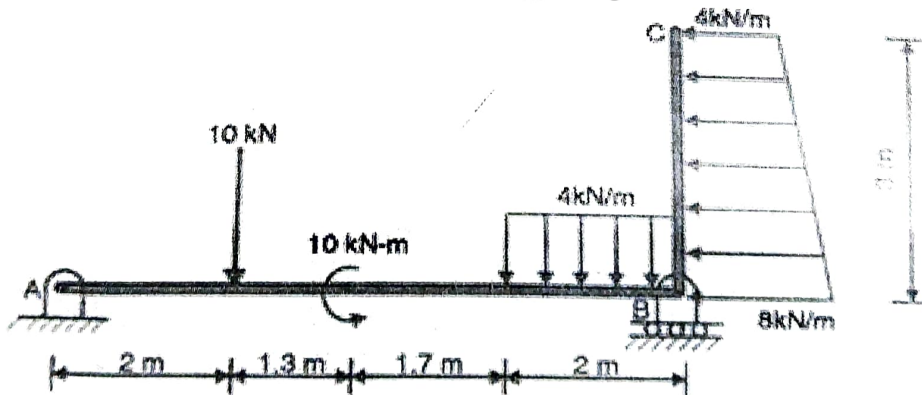**B)** Find the centroid of the shaded areas shown in the fig.   (07)
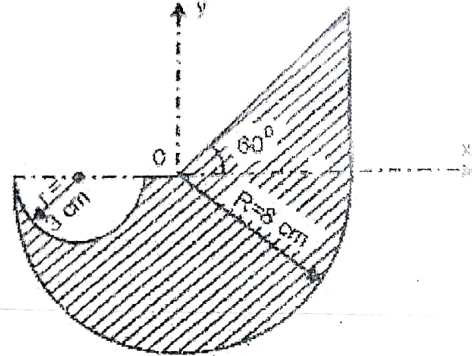
C) A particle starts from rest from origin and its acceleration is given by

$$a = \frac{k}{(x+4)^2}$$

Knowing that v = 4 m/s when x = 8 m. Find value of k, Also calculate the velocity when displacement is 10 m.   (06)

Q 3 Find the support reactions of beam loaded as shown in fig.   (07)
**A)**

B) A uniform ladder rests with one end against a smooth vertical wall and other end on the ground, whose coefficient of friction is 0.5. If the inclination of ladder to the ground is 50^0, find the position of a man (whose weight is same as ladder) from the bottom of the ladder when the ladder is at the verge of slipping. The length of ladder is 8 m.   (07)

C) A particle moves in x-y plane with acceleration components $a_x = -3 m/s^2$ and $a_y = -16t\ m/s^2$. If its initial velocity is $V_0 = 50$ m/s directed at 35° to the x-axis, compute the radius of curvature of the path at t = 2 sec. Also calculate the velocity at t = 5 Sec. (06)

Q 4. A dam is subjected to three forces, 50 kN
A) on the upstream face AB, 30 kN force on the downstream inclined face and its own weight of 120 kN as shown in figure. Determine the single force and locate its point of intersection with the base AD assuming all the forces to lie in a single plane. (07)
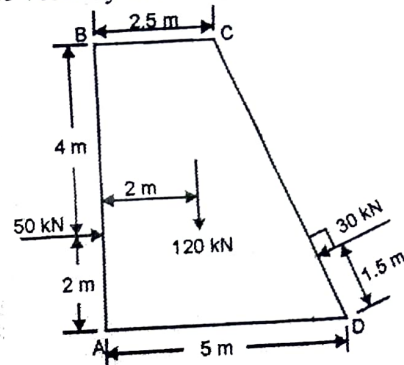
B) A boy throws a ball so that it may clear a wall 3.6 m high. The boy is at a distance of 4.8 m from the wall. The ball was found to hit the ground at a distance of 3.6 m on the other side of the wall, Find the least velocity with which the ball can be thrown, and the corresponding angle of projection. (07)
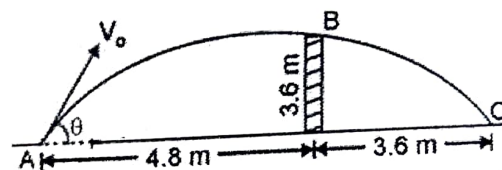
C) For the mechanism shown in figure, the angular velocity of bar *AB* is 3 rad/s clockwise. Using instantaneous center of rotation, calculate the angular velocity of bar *BC* and the velocity of slider *C* for this position (06)
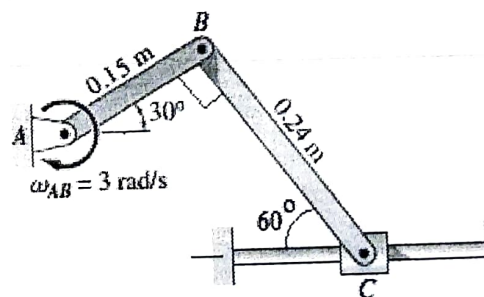
Q 5. A tower is held in position by three cables.
A) Determine position (x, y) for the cable DA so that the resultant force exerted is directed from D to O. (10)
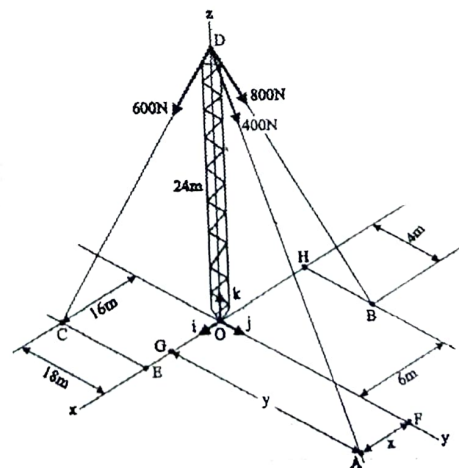
B) Fig shows a-t curve for a particle moving along x axis what is speed & distance covered by the particle after 50 sec? Find also the maximum speed & the time at which the speed is attain by the particle, also plot v-t & x-t curve. (10)
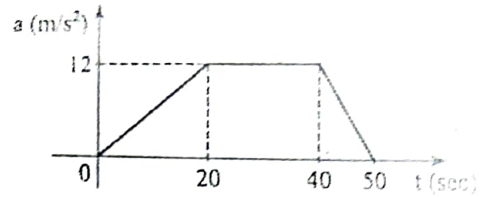
Q 6.
A) A block of weight 800 N is acted upon by a horizontal force P as shown in figure, if $\mu_s = 0.35$ & $\mu k = 0.25$, determine the value of P for impending motion up the plane. (05)
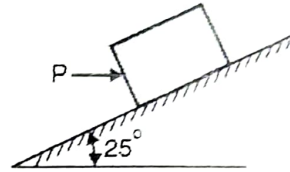
B) A wheel of radius 0.75 m rolls without slipping on a horizontal surface. Determine the velocities of point P and Q shown in figure, when the velocity of centre of the wheel is 10 m/s towards right. (05)
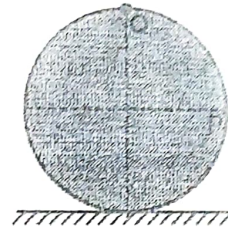
C) `A wheel of weight W = 1000 N rest on a smooth incline plane. It is kept from rolling down the plane by a string AC. Find the tension in the string and reaction at the point of contact D. (05)
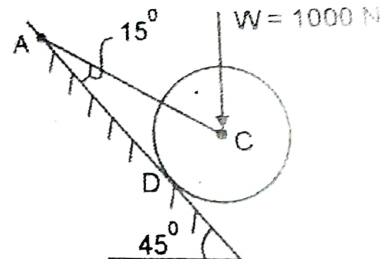
D) A train starting from rest accelerates uniformly for 3 minutes, runs at constant speed for next 5 minutes and then come to rest in next 2 min. If it covers a total distance of 9 km. draw V- t diagram and find the acceleration and retardation in m/s² [05]

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QP code: 10068664

FE sem-I All Branches R-19 C scheme

Time: 2 hours

Maximum marks: 60

NB:

1) Question No.1 is Compulsory

2) Attempt any Three questions from the remaining Five questions

3) Figures to the right indicate full marks

4) Atomic weight: Ca = 40, Mg = 24, S = 32, Cl = 35.5, C = 12, H = 1, O = 16, Na = 23.

Q.1 Attempt any **five** of the following: (15)

a) Compare temporary and permanent hardness (any 3 points).

b) At room temperature, H_2O is liquid and H_2S is a gas. Justify.

c) Comment on glass transition temperature (Tg).

d) Give difference between bonding and antibonding orbitals.

e) Identify how many phase/s are present in each of the following systems;

 1) Mixture of N_2, H_2 and O_2

 2) Mixture of rhombic and monoclinic Sulphur

 3) Ethanol and water

f) Explain drawbacks of Kekule's Benzene structure.

g) Calculate COD of 25 ml of waste water sample in ppm which was refluxed with 10 ml of $K_2Cr_2O_7$ and after refluxing the excess unreacted dichromate required 6.5 ml of 0.1N FAS solution. A blank of 25 ml of distilled water on refluxing with 10 ml of $K_2Cr_2O_7$ solution required 27 ml of 0.1N FAS solution.

Q.2) a) Apply Gibb's phase rule to one-component (Water) system. (6)

b) Explain reverse osmosis with the help of principle, process, and diagram. Also give its advantages. (5)

c) Discuss the roles of plasticizer and lubricant in compounding of plastics. (4)

Q.3) a) Draw the Molecular Orbital diagram of CO molecule. Give its electronic configuration. Calculate its bond order and identify its magnetic behaviour. (6)

b) What is hydrogen bonding? Explain its types with examples. (5)

c) Calculate number average molecular weight of polymer which has 5 molecules of molecular weight of 10000, 3 molecules of molecular weight 30000 and 2 molecules of molecular weight 60000. (4)

Q.4) a) Explain Gibbs phase rule with its mathematical expression. Give its (6) limitations and advantages.

b) Comment on structure and bonding of pyrrole. (5)

c) Explain n-type and p-type conducting polymers with appropriate (4) examples.

Q.5) a) Define fabrication of plastics. Explain injection moulding process with (6) neatly labelled diagram. Give its any two advantages.

b) Distinguish between orbit and orbital (any three points). Explain the (5) shapes of p-orbitals with their diagrams.

c) Write equations representing EDTA titration. (4)
Calculate total hardness of water in ppm, if 50 ml of standard hard water sample containing 1 mg of pure $CaCO_3$ per ml consumed 20 ml of EDTA solution and 50 ml of hard water sample required 30 ml of EDTA solution.

Q.6) a) Explain the ion-exchange method for softening of water giving the (6) following details: Principle, diagram, process, and Reactions.

b) i) Define: Phase and Component. (2)

ii) An alloy of tin and lead contains 73% tin. Find the mass of eutectic in (3) 1kg of solid alloy, if the eutectic contains 64% of tin.

c) Draw Molecular Orbital diagram of O_2 molecule. (2)

ii) Give synthesis of Kevlar. (2)

11/01/24

Q.P. Code: 10066804

FE Sem-1 All branches R-19 cScheme EM-I

Duration: 3hrs

[Max Marks: 80]

N.B.: (1) Question No 1 is Compulsory.

(2) Attempt any three questions out of the remaining five.

(3) All questions carry equal marks.

1 a Find the continued product of all the roots of $\left(\dfrac{1}{2} - i\dfrac{\sqrt{3}}{2}\right)^{3/4}$. [5]

b If $\tan\left(\dfrac{\pi}{8} + i\alpha\right) = x + iy$, prove that $x^2 + y^2 + 2x = 1$. [5]

c Find the nth order derivative of $e^{2x}\cos 5x.\cos x$. [5]

d Prove that $\log(1 + \sin x) = x - \dfrac{x^2}{2} + \dfrac{x^3}{6} -$ [5]

2 a Separate into real and imaginary parts $\cos^{-1}\left(\dfrac{5i}{12}\right)$. [6]

b Investigate for what values of λ and μ do the equations $2x + 3y + 5z = 9$,
$7x + 3y - 2z = 8, 2x + 3y + \lambda z = \mu$ have [6]

    (i)   no solution
    (ii)   an unique solution
    (iii)   an infinite number of solutions.

c Solve the following equations by using Jacobi's iterative method [8]
$15x + 2y + z = 18, 2x + 20y - 3z = 19, 3x - 6y + 25z = 22$ up to six iterations.

3 a If $u = f(e^{x-y}, e^{y-z}, e^{z-x})$, then prove that $\dfrac{\partial u}{\partial x} + \dfrac{\partial u}{\partial y} + \dfrac{\partial u}{\partial z} = 0$ [6]

b Express $\sin^7\theta$ in terms of sines and cosines of multiples of θ. [6]

c Find the value of (i) $\tanh(\log\sqrt{6})$ (ii) $\sin(\log(i^i))$ [8]

4 a Show that $\dfrac{\partial^2 z}{\partial x^2} = a^2\dfrac{\partial^2 z}{\partial y^2}$, if $z = \tan(y + ax) + (y - ax)^{3/2}$, [6]

b Use the test of rank to solve completely the system of equations [6]
$4x - y + 2z + w = 0, 2x + 3y - z - 2w = 0, 7y - 4z - 5w = 0$,
$2x - 11y + 7z + 8w = 0$.

c If $y = \sin(m\sin^{-1}x)$ then prove that [8]
$(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} + (n^2 - m^2)y_n = 0$.

5   a   Find the extreme values of $x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$.   [6]

  b   Check whether the matrix $A = \begin{bmatrix} \cos\alpha & 0 & \sin\alpha \\ 0 & 1 & 0 \\ -\sin\alpha & 0 & \cos\alpha \end{bmatrix}$ is orthogonal or not. If yes,   [6]
then find the inverse of A.

  c   Determine the root using Regular-Falsi method of $x^4 + x^3 - 7x^2 - x + 5 = 0$ [8]
which lies between 2 and 3 correct up to 3 places of decimal.

6   a   Find two non-singular matrices P and Q such that PAQ is in normal form for   [6]
$$A = \begin{bmatrix} 2 & 1 & 4 \\ 3 & 2 & 2 \\ 7 & 4 & 10 \\ 8 & 5 & 8 \end{bmatrix}$$

  b   If $u = \tan^{-1}\left(\frac{x^2+y^2}{x-y}\right)$ then prove that   [6]

$$x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = -2\sin^3 u \cos u$$

  c   Find the roots of the equation $x^4 + 1 = 0$ and $x^5 - 1 = 0$ [8]

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66804

FE sem-I All Branches R-19 C scheme

(Time: 2 Hours)   [Total Marks: 60]

N.B.: (1) Question No. **1** is **compulsory.**
   (2) Attempt **any three** questions from Q.2 to Q.6.
   (3) Assume **suitable** data wherever **required.**
   (4) Figures to the right indicate marks.

Q.1   Attempt any **FIVE**   (15)

   (a)   The resistivity of cu is 1.72×10^{-8} ohm-m. Calculate the mobility of electron in Cu. Given that the number of electrons per unit volume is 10.41×10^{28}/m3

   (b)   Draw the following with reference to cubic unit cell:
         (110),(011) and(101)

   (c)   Why do we see beautiful colors in thin film when it is exposed to sunlight?

   (d)   What are the properties of matter waves?

   (e)   Explain the principle & importance of super capacitors

   (f)   Explain the construction of LCD

   (g)   State de Broglie's hypothesis. Deduce an expression for the wavelength of de Broglie's matter waves.

Q.2   (a)   What is thin film? Derive the conditions for maxima & minima due to interference of light reflected from thin film of uniform thickness   (08)

   (b)   Derive Bragg's law. The Braggs angle corresponding to the first order reflection from (111) planes of a crystal is 30^0.wavelength of X-rays is $1.75 \, A^0$.Determine lattice constant of the crystal.   (07)

Q.3   (a)   Explain phase velocity & group velocity of a matter waves. Derive the one dimensional time dependent Schrodinger wave equation for matter waves.   (08)

   (b)   What is photovoltaic effect? Explain the principle, working & applications of solar cell.   (07)

Q.4   (a)   Calculate electron and hole concentration in intrinsic silicon at room temperature if its electrical conductivity is 4×10^{-4} mho/m. (mobility of electron=0.14 m^2/V-s & mobility of hole=0.04 m^2 /V-s)   (05)

   (b)   Show that the energy of an electron in a box varies on the square of the natural numbers.   (05)

   (c)   In Newton's ring experiment the diameter of 4th and 12th dark rings are 0,40cm and 0.70cm.find diameter of 20th dark ring in reflected light.   (05)

Q.5   (a)   Write the applications of superconductors.   (05)

   (b)   Show that Fermi energy level is placed in the center of the energy band gap in intrinsic semiconductors.   (05)

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(c) Explain Heisenberg's uncertainty principle with example & give its physical (05) significance

Q.6 (a) What is Meissner Effect? With the help of this effect show that superconductors (05) are diamagnetic in Nature.

(b) A parallel beam of light (wavelength-5870) is incident on a glass plate of Refractive (05) Index is 1.5,such that the angle of refraction into the plate is 60 ^{0}.calculate the smallest thickness of the glass plate which will appear dark by reflection

(c) If the uncertainty in position of an electron is 4×10^{-10} m, calculate the uncertainty (05) in its momentum.