University of Mumbai
Examinations Summer 2022
Program No: 1T01831
Examination: F.E. (Sem I) (ALL BRANCHES) (Rev 2019 'C'-Scheme)
Subject (Paper Code): 58651 // Engineering Mathematics - I

Time: 2 hour 30 minutes   Max. Marks: 80

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Q I.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks.
1.	The value of $\left(\frac{1}{\sqrt{2}} + \frac{i}{\sqrt{2}}\right)^{10} + \left(\frac{1}{\sqrt{2}} - \frac{i}{\sqrt{2}}\right)^{10}$ is equal to
Option A:	$\frac{\pi}{2}$
Option B:	0
Option C:	$\frac{\pi}{3}$
Option D:	$\frac{\pi}{4}$
2.	What is the value of $\log(i)$
Option A:	$i\frac{\pi}{2}$
Option B:	0
Option C:	-2
Option D:	$-i\frac{\pi}{2}$
3.	If $u = \log(\tan x + \tan y)$ then the value of $\sin 2x \frac{\partial u}{\partial x} + \sin 2y \frac{\partial u}{\partial y}$ is
Option A:	2
Option B:	-1
Option C:	0
Option D:	- 2
4.	All the stationary points of the function $x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$ are
Option A:	$(6,0), \quad (4,0), \quad (5,1), \quad (5,-1)$
Option B:	$(6,4), \quad (4,0), \quad (5,0), \quad (5,1)$
Option C:	$(6,0), \quad (0,0), \quad (5,1), \quad (5,-1)$
Option D:	$(0,0), \quad (4,0), \quad (5,1), \quad (5,-2)$
5.	If $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 3 \end{bmatrix}$, then rank of A is
Option A:	2
Option B:	3
Option C:	1
Option D:	0

6.	The modulus and principal value of the argument of $\frac{(1+i\sqrt{3})^{13}}{(\sqrt{3}-i)^{11}}$ is
Option A:	$\frac{1}{4}(cos\frac{\pi}{6} + isin\frac{\pi}{6})$
Option B:	$4(cos\frac{\pi}{3} + isin\frac{\pi}{3})$
Option C:	$\frac{1}{4}(cos\frac{\pi}{3} + isin\frac{\pi}{3})$
Option D:	$4(cos\frac{\pi}{6} + isin\frac{\pi}{6})$
7.	The real part of $cos^{-1}\left(\frac{3i}{4}\right)$ is
Option A:	π
Option B:	2π
Option C:	$-\pi$
Option D:	$\pi/2$
8.	If $u = \frac{\sqrt{xy}}{\sqrt{x}+\sqrt{y}}$ then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is
Option A:	$\frac{u}{2}$
Option B:	$\frac{-u}{2}$
Option C:	$2u$
Option D:	$\sqrt{2}\,u$
9.	Stationary point is a point where $f(x,y)$ has
Option A:	$\frac{\partial f}{\partial x} = 0$
Option B:	$\frac{\partial f}{\partial y} = 0$
Option C:	$\frac{\partial f}{\partial x} = 0, \;\; \frac{\partial f}{\partial y} = 0$
Option D:	$\frac{\partial f}{\partial x} < 0 \;\; \frac{\partial f}{\partial x} > 0$
10.	For non-singular matrices P and Q, PAQ is in the normal form of a matrix A, then A^{-1} can be found by
Option A:	$A^{-1} = Q^{-1} P$
Option B:	$A^{-1} = P\, Q^{-1}$
Option C:	$A^{-1} = QP$
Option D:	$A^{-1} = Q\, P^{-1}$

Q II. (20 Marks)	Solve any Four out of Six.	5 marks each
A	Prove that: $\frac{\sin 6\theta}{\sin 2\theta} = 16cos^2\theta - 16cos^2\theta + 3$	
B	Considering only principal values separate into real and imaginary parts $i^{\log(1+i)}$.	
C	If $z = tan^{-1}\left(\frac{y}{x}\right)$, find the value of $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2}$.	
D	Find the extreme value of the function $xy(3 - x - y)$.	
E	Express the matrix $\begin{bmatrix} 3i & -1+i & 3-2i \\ 1+i & -i & 1+2i \\ -3-2i & -1+2i & 0 \end{bmatrix}$ as a sum of Hermitian and skew Hermitian matrix.	
F	If $y = a\cos(logx) + b\sin(logx)$, then show that $x^2 y_{n+2} + (2n + 1)x\, y_{n+1} + (n^2 + 1)y_n = 0.$	

Q III. (20 Marks)	Solve any Four out of Six.	5 marks each
A	Find all the values of $(1 + i)^{\frac{1}{3}}$ and show that their continued product is $(1 + i)$.	
B	Separate into real and imaginary parts $tan^{-1}(\alpha + i\beta)$	
C	If $u = sin^{-1}\frac{x+y}{\sqrt{x}+\sqrt{y}}$, prove that $x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x\partial y} + y^2\frac{\partial^2 u}{\partial y^2} = -\frac{\sin u\,\cos 2u}{4\cos^3 u}.$	
D	Divide 24 into 3 parts such that the continued product of the first, square of second and cube of the third is maximum using Lagrange's method.	
E	Find a, b, c if A is orthogonal matrix where A $=\frac{1}{3}\begin{bmatrix} a & b & c \\ -2 & 1 & 2 \\ 1 & -2 & 2 \end{bmatrix}$. Hence find inverse of A.	
F	Investigate for what values of λ and μ the system of equations $x + y + z = 6$; $x + 2y + 3z = 10$; $x + 2y + \lambda z = \mu$ has (i) no solution (ii) a unique solution (iii) an infinite no. of solutions.	

Q IV. (20 Marks)	Solve any Four out of Six.	5 marks each
A	Prove that $(1 + i\sqrt{3})^n + (1 - i\sqrt{3})^n = 2^{n+1}\cos\frac{n\pi}{3}.$	
B	Prove that $\sinh^{-1}(\tan\theta) = log\left[\tan\left(\frac{\pi}{4} + \frac{\theta}{2}\right)\right]$	
C	If $u = f\left(\frac{y-x}{xy}, \frac{z-x}{xz}\right)$, then show that $x^2\frac{\partial u}{\partial x} + y^2\frac{\partial u}{\partial y} + z^2\frac{\partial u}{\partial z} = 0$	
D	Find n^{th} derivatives of $\frac{x}{(x-1)(x-2)(x-3)}$.	

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E	Find non-singular matrices P and Q such that $A = \begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$ is reduced to normal form. Also find its rank.
F	Using De Moivre's theorem prove that $$cos^6\theta - sin^6\theta = \frac{1}{16}(cos6\theta + 15cos2\theta).$$

University of Mumbai

Examinations Summer 2022

Program: First Year Engineering

Curriculum Scheme: Rev. 2019 C Scheme

Examination: FE Semester I

Course Code: FEC102 and Course Name: Engineering Physics-I

Time: 2-hour   Max. Marks: 60

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Q1.	Choose the correct option for following questions. All the Questions are compulsory. (2 Marks each)
1.	When a ray of light is traveling from a denser medium to rarer medium the refracted ray _____
Option A:	Changes phase by $\pi/2$
Option B:	Changes phase by $\pi/4$
Option C:	Changes phase by $3\pi/2$
Option D:	Does not change phase
2.	The de Broglie wavelength of an electron which has been accelerated from rest through a potential of 64V is
Option A:	3.258 A.U.
Option B:	2.228A.U.
Option C:	1.535 A.U.
Option D:	1.228 A.U.
3.	In which band the Fermi level of n-type semiconductor overlaps if the impurity concentration is increased?
Option A:	Intrinsic fermi level
Option B:	Conduction band
Option C:	Valence band
Option D:	Acceptor level
4.	The minimum thickness of a parallel film, of R.I. μ, illuminated with light for which it appears bright is
Option A:	$\lambda/(2\mu)$
Option B:	$\lambda/(4\mu)$
Option C:	$2\lambda/(4\mu)$
Option D:	$3\lambda/(4\mu)$
5.	The interplanar spacing for a (111) plane in simple cubic crystal whose lattice constant is 4×10^{-8} cm is
Option A:	1.123 A°
Option B:	2.309 A°
Option C:	1.561 A°
Option D:	1.981 A°
6.	The critical magnetic field for Vanadium is 10^5 A/m at 8.58°K and 2×10^5 A/m at 0°K. Its critical temperature is
Option A:	12.133 K
Option B:	14.133 K
Option C:	13.533 K

Option D:	11.133 K

Q2	**Answer any 4 questions out of 6**	**(4 marks each)**
A	A mixture of red light of wavelength 6600A^0 and blue light of wavelength 4400A^0 is incident normally on an air film formed between two glasses plates. The thickness of the air film is 3300A^0. What is the color of light reflected by the air film?	
B	A copper strip 1cm wide and 1mm thick is placed in a magnetic field B= 1.5 Wb/m^2. If current of 200A is set up in the strip, calculate Hall voltage that appears across the strip. Given, R_H= 6 x 10^{-7} m^3/C.	
C	The spacing between the nuclei of certain crystal is 1.2 A°. At what angle will first order Bragg's reflection occur for thermal neutrons (Given: mass of neutron is 1.67 x 10^{-27} Kg and kinetic energy of neutrons is 0.025eV).	
D	Describe the method for determination of wavelength of light using Newton's ring set up.	
E	Discuss the effect of variation in temperature on the fermi energy level of n-type semiconductor with the help of labelled diagram.	
F	Derive the expression for energy eigen values for free particle in one dimensional potential well.	

Q3	**Answer any 4 questions out of 6**	**(4 marks each)**
A	What are Miller Indices? Draw the following in a cubic unit cell. i) (1 2 3) ii) ($\bar{1}$ 0 $\bar{2}$) iii) (0 0 $\bar{2}$)	
B	Show that the intrinsic fermi level lies in the middle of the band gap.	
C	Prove that fringe width is constant in a wedge-shaped thin film set up.	
D	Derive the Schrodinger's time independent differential equation for matter waves.	
E	Distinguish between Type I and Type II superconductors.	
F	What is the probability of an electron being thermally excited to the conduction band in Si at 30°C? The band gap energy is 1.12eV.	

Q4	**Answer any 4 questions out of 6**	**(4 marks each)**
A	What is De-Broglie's hypothesis? Derive expression for De Broglie's wavelength.	
B	Explain the construction and working principle of a Light Emitting Diode.	
C	Monochromatic X-rays are incident on a crystal. If first order reflection is observed at a glancing angle of 3.4°, at what angle would the second order reflection is expected?	
D	The ground state energy of an electron in an infinite well is 5.6 x10-3 eV. What will be the ground state energy if the width of the well is doubled?	
E	What is antireflection coating? What should be the refractive index and minimum thickness of the coating?	
F	What is Meissner's effect? Show that a superconductor is a perfect diamagnet.	

University of Mumbai

Examinations Commencing from 28th June 2022
Program: First Year (All Branches)
Curriculum Scheme: Rev 2019 – C Scheme
Examination: **FE Semester I**

Program Code: **1TO1831//F.E(SEM-I) (all branches)(Rev-2019,'C'scheme)**

Subject code: **58655/2019/Engineering Chemistry –I**

Course Name: **Engineering Chemistry I**

Time: 2 hour   Max. Marks: 60

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0607_R19_FE_I_FEC103_QP1

1	Attempt all questions
2	Atomic weights:- H=1, C= 12, N=14, O=16, Mg=24, S=32, K= 39, Ca= 40

Q.1	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks. 2 marks each**
1.	A 5ml sample of waste water was refluxed with 30ml of potassium dichromate solution and after refluxing the excess unreacted dichromate required 23ml of 0.1M FAS solution. A blank of distilled water on refluxing with 30ml of dichromate solution required 33ml FAS solution. Calculate the COD value of the waste water.
Option A:	2080 ppm
Option B:	1600 ppm
Option C:	800 ppm
Option D:	2000 ppm
2.	Which of following compound is not aromatic?
Option A:	Pyrrole
Option B:	Cycloheptatriene
Option C:	Cyclopentadienyl anion
Option D:	Naphthalene
3.	Which statement is true for thermoplastics?
Option A:	Thermoplastic do not soften on heating
Option B:	Thermoplastic are crosslinked Macromolecules
Option C:	Thermoplastic are organic solvent insoluble
Option D:	Thermoplastic is prepared by Addition Polymerization
4.	What will be Number of Phases at Eutectic Point?
Option A:	1
Option B:	2
Option C:	3
Option D:	4
5.	Which of the following impurity is not responsible for hardness?

Option A:	NaCl
Option B:	$MgCl_2$
Option C:	$AlCl_3$
Option D:	$CaCl_2$
6.	Which of the following is correct bond order for molecule 'NO'
Option A:	1
Option B:	2
Option C:	2.5
Option D:	3

Q.2	Solve <u>any Four</u> out of the following	4 marks each
a)	0.28g of $CaCO_3$ was dissolved in HCl and Solution Made up to 1litre with distilled Water.50 ml of above solution required 14ml of EDTA solution. 100ml of Hard water sample required 33 ml of EDTA solution. After boiling of this water, cooling and filtering 50ml of this solution on titration required 2.5 ml of EDTA solution. Calculate each type of Hardness of water.	
b)	State Gibbs phase rule and explain the terms involved in it.	
c)	Explain the aromaticity of Pyrrole with a diagram.	
d)	Write a brief note on 'Conducting Polymers'	
e)	Draw a neat sketch and explain the Electro-dialysis process used in purification of water.	
f)	Draw and explain the Phase diagram of water.	

Q.3	Solve <u>any Four</u> out of the following	4 marks each
a)	With a neat labeled diagram explain transfer molding of plastic material.	
b)	With the help of electronic configuration, draw the M.O diagram of CO molecule and explain its bond order and magnetic property.	
c)	Explain eutectic point, with the help of neat and labeled phase diagram of two component system.	
d)	Write a brief note on Ion Exchange process of softening of hard water.	
e)	Differentiate between Thermoplastic and Thermosetting Polymers.	
f)	Justify: - Why does Anthracene qualify as an aromatic molecule but Cyclobutadiene does not?	

Q.4	Solve <u>any Four</u> out of the following	4 marks each
a)	Give a brief account of Ultrafiltration.	
b)	Why Plasticizers and fillers are added during compounding of the plastic?	
c)	Explain why Benzene is an aromatic molecule?	
d)	Explain with MO diagram, Why Be_2 does not exist?	
e)	What are factors that affect glass transition temperature?	
f)	Write any two important advantages and limitations of phase rule?	
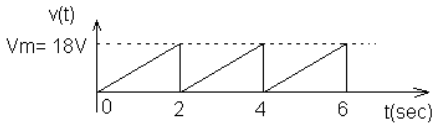
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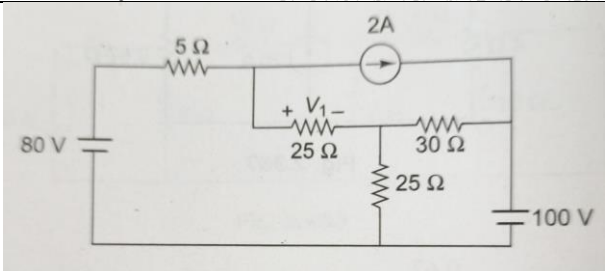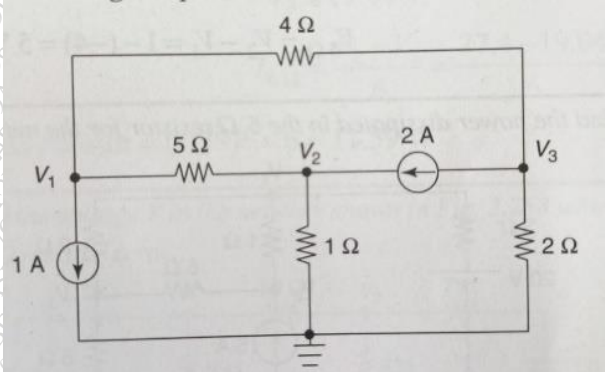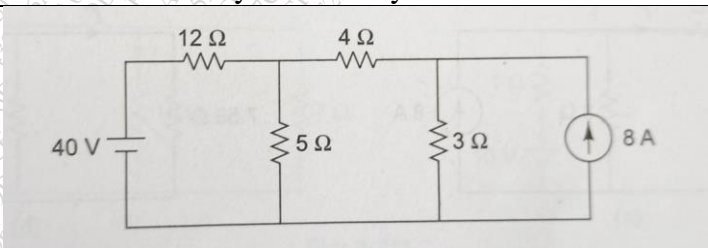
Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	Internal Resistance of an ideal current source is
Option A:	Infinity
Option B:	Zero
Option C:	Maximum
Option D:	Minimum
2.	In a circuit, an internal resistance of 10 ohm is connected in series with a load resistance. A dc voltage of 100V is applied to it. At what value of load resistance, maximum power will be transferred to the load.
Option A:	Infinity ohm
Option B:	10 ohm
Option C:	20 ohm
Option D:	Zero ohm
3.	Form factor is a ratio of …..
Option A:	Rms value to maximum value
Option B:	Maximum value to rms value
Option C:	Maximum value to Average value
Option D:	Rms value to Average Value.
4.	Rms value of a pure sine voltage wave is
Option A:	Vm/2
Option B:	2Vm
Option C:	Vm/√2
Option D:	Vm/π
5.	A voltage of 200<50 volts is applied to an impedance. Current flowing through the circuit was 10<20 ampere. What will be the impedance of the circuit.
Option A:	20<70
Option B:	20<30
Option C:	2000<30
Option D:	2000<70
6.	Power absorbed by purely capacitive circuit is
Option A:	Zero
Option B:	Infinity
Option C:	More than apparent power
Option D:	Less than apparent power
7.	Condition for series resonance is
Option A:	XL=XC/2
Option B:	XL=XC
Option C:	XL=ZL
Option D:	ZL=R

8.	Current at parallel resonance is
Option A:	Maximum
Option B:	V/R
Option C:	Minimum
Option D:	Zero
9.	Which Motor is not self-starting
Option A:	Dc shunt Motor
Option B:	Dc series Motor
Option C:	Single phase Induction motor
Option D:	Three phase induction motor
10.	In two wattmeter method reading of the two wattmeters are 300W and 500W. Calculate three phase reactive power in the circuit.
Option A:	282.84
Option B:	200
Option C:	222
Option D:	346.41

Q2		**(20 Marks Each)**
A	**Solve any One**	**10 marks each**
i.	A circuit consists of a pure resistor and a coil in series. Power dissipated in the resistor and in the coil are 1000W and 250W respectively. The voltage drops across the resistor and the coil are 200V and 300V respectively. Determine value of resistance, resistance and reactance of a coil, combined resistance and impedance of the coil and supply voltage.	
ii.	Instantaneous voltages across each of four impedances connected in series are given below. Find the resultant applied voltage. v1= 100 sinωt, v2=250 cosωt, v3=150 Sin(ωt+π/6), v4= 200sin(ωt-π/4)	
B	**Solve any One**	**10 marks each**
i.	Three similar choke coils are connected in star to a three phase supply. If the line current is 15A, the total power consumed is 11KW and the voltampere input is 15KVA, find the line and phase voltages, the VAR input and the reactance and resistance of each coil.	
ii.	Prove that two wattmeter method can measure the power in three phase star connected circuit.	

Q3		**(20 Marks Each)**
A	**Solve any One**	**10 marks each**
i.	 Find Vrms of the wave.	

ii.	A coil is connected across a 250V, 50 Hz supply takes a current of 10A at 0.8 lag pf. What will be the power taken by the coil. Now if the same coil is connected across 200V, 25Hz supply, what will be the power taken.	
B	**Solve any One**	**10 marks each**
i.	A series RLC circuit is connected to 200V ac supply. The current drawn by the circuit is 20A at the resonance. The voltage drop across capacitor at resonance is 5000V. Find resistance and inductance if capacitance value is 4 µF. Calculate resonant frequency.	
ii.	Explain construction of three phase motor.	

Q4		**(20 Marks Each)**
A	**Solve any One**	**10 marks each**
i.	Find voltage across 25 ohm using mesh analysis.	
ii.	Explain classification DC motor.	
B	**Solve any One**	**10 marks each**
i.	Find V1 and V2 by nodal analysis.	
ii.	Find current in 3 ohm by thevenin's theorem.	

University of Mumbai

Curriculum Scheme: Rev2019

All Programs

Examination: FE Semester I   FH2022

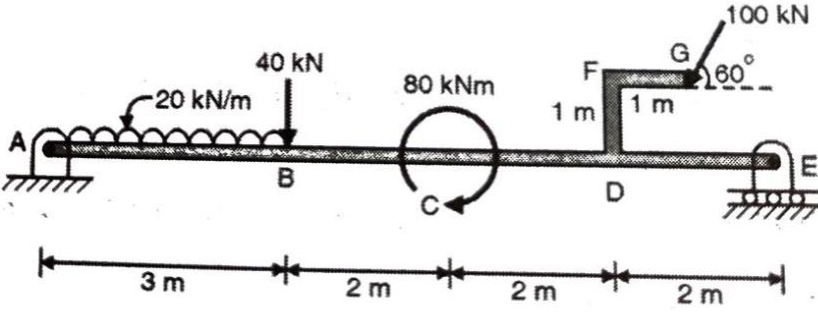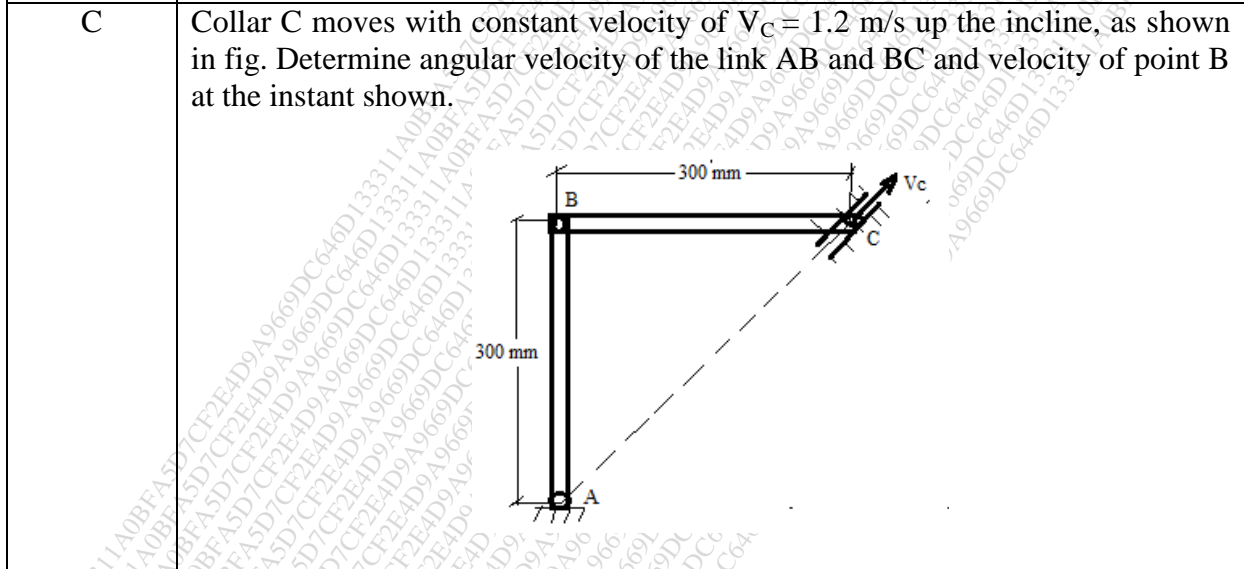Course Code: FEC104   Course Name: Engineering Mechanics
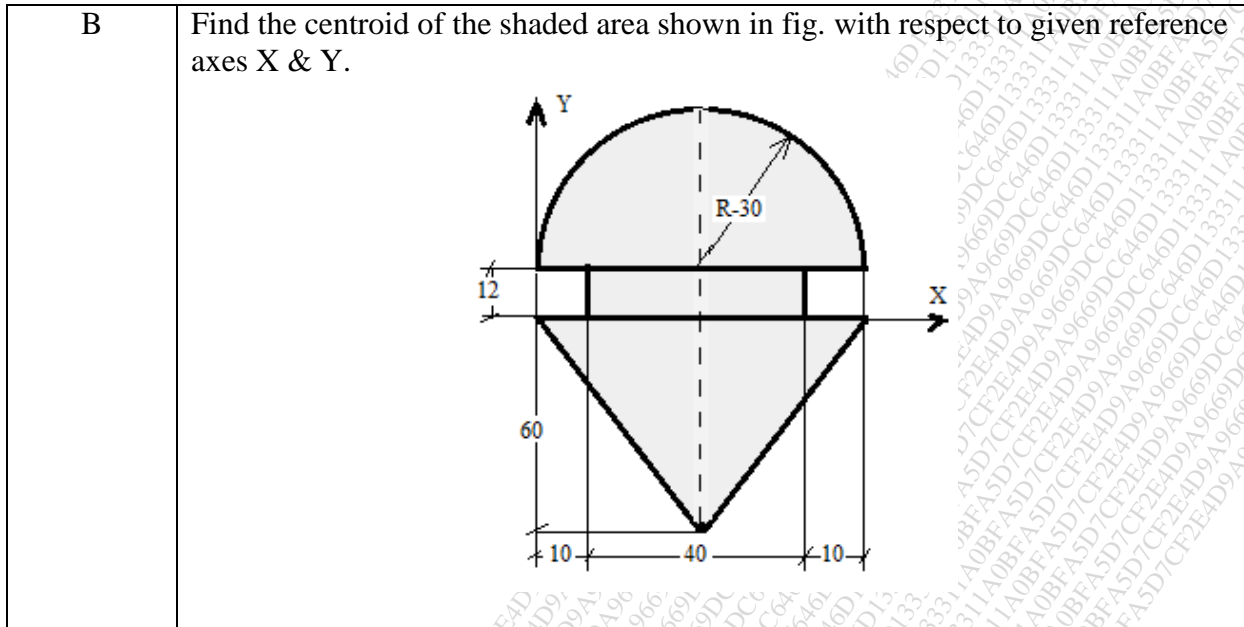
Time: 2.5 hours   Max. Marks: 80

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Instructions :**1. All the questions are compulsory.**

    2. Each questions carry equal marks.

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Q1.	Choose the correct option for following questions. All the Questions arecompulsory and carry 2 marks each
1.	Pushing or pulling of a vehicle with same magnitude of force along the same line of action is called as _____.
Option A:	Equilibrium
Option B:	Principle of transmissibility
Option C:	Newtons III law
Option D:	Newtons II law
2.	Ratio of limiting friction and normal reaction is _____.
Option A:	Coefficient of friction
Option B:	Angle of friction
Option C:	Sliding friction
Option D:	Coefficient of restitution
Q3.	Any lamina when hangs freely at any corner of the lamina, then the vertical line ....
Option A:	Will pass through bottom left corner
Option B:	Will pass through bottom right corner
Option C:	Will pass through the centroid of a lamina.
Option D:	Will never pass through the centroid of a lamina.
Q4.	Conditions of equilibrium for coplanar concurrent force system are....
Option A:	2
Option B:	3
Option C:	0
Option D:	All above
Q5.	Where we apply Varignon's Theorem...
Option A:	To find magnitude of Resultant force.
Option B:	To find magnitude of Equilibrant force
Option C:	To find direction of resultant and equilibrant force.
Option D:	None of above three

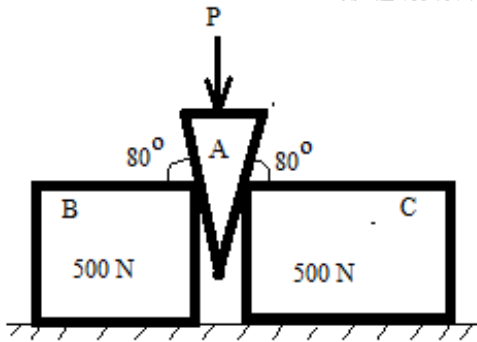A0BFA5D7CF2E4D9A9669DC646D133311

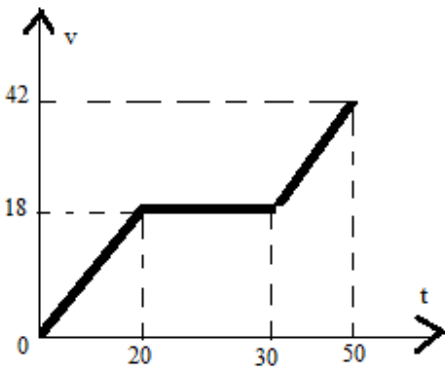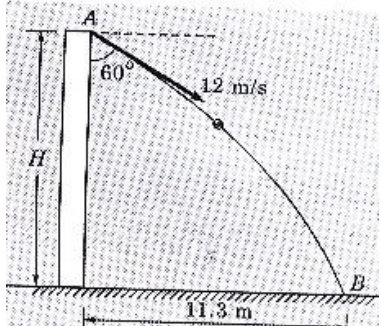|	
Q6.	Equilibrant force is always....
Option A:	Equal in magnitude, opposite in direction and collinear with Resultant force.
Option B:	Equal in magnitude, direction and collinear with Resultant force.
Option C:	Equal in magnitude, opposite in direction and parallel with Resultant force.
Option D:	None of above three.
Q7.	Two parallel equal forces acting in the opposite direction
Option A:	balance each other
Option B:	constitute a moment
Option C:	constitute a force couple system
Option D:	constitute a moment of the couple
Q8.	If stone is projected vertically up, its time of flight is_____.
Option A:	Inversely proportion to its mass
Option B:	Proportional to its initial velocity
Option C:	Proportional to its mass
Option D:	Inversely proportional to its initial velocity
Q9.	Velocity-time curve for the body projected vertically upwards is a_____.
Option A:	Straight line inclined to the time axis
Option B:	parabola
Option C:	ellipse
Option D:	curve
Q10.	Two force member is a ....
Option A:	Member which is connected at the ends, consider weightless and no external force acts along the member.
Option B:	Member which is connected anywhere; consider its own weight and no external force acts along the member.
Option C:	Member which is connected at the ends, consider its own weight and external forces acts along the member.
Option D:	All above are correct.

Q2	**Solve any Two.**	**[10 marks each]**
A	Find the reactions at the supports A & B for the given beam shown in fig.	

B	Find the centroid of the shaded area shown in fig. with respect to given reference axes X & Y.
C	Collar C moves with constant velocity of $V_C = 1.2$ m/s up the incline, as shown in fig. Determine angular velocity of the link AB and BC and velocity of point B at the instant shown.

Q3.	Solve any Two. [10 marks each]
A	A concurrent system of forces is shown in the **Error! Reference source not found.**.' Find the resultant passing through the origin

B	A wedge 'A' of negligible weight is to be driven between two 500 N blocks B and C. Knowing that the coefficient of friction is 0.35 between the blocks and the horizontal surface and zero between the wedge and each of the block ,Determine the force P required to start moving wedge if the blocks are equally free to move.
C	A stone is thrown vertically upward with a velocity 20 m/s while coming down it strikes a glass pan held half the height through which it has rises and losses half of its velocity in breaking the glass. Find the velocity of stone with which it strikes the ground.

Q4.	**Solve any Two.**	**[10 marks each]**
A	The race car starts from rest and travels along a straight road until it reaches a speed of 42 m/s in 50 sec. as shown by v-t graph. Determine the distance travelled by race car in 50 sec. draw x-t and a-t graph.	
B	A ball thrown with a speed of 12m/s at an angle of 60^0 with a building strikesthe ground 11.3m horizontally from the foot of the building as shown in fig. Determine the height of the building and the velocity of ball with which it strikes the ground.	

C	The jib crane shown in fig is subjected to three coplanar forces. Replace this loading by an equivalent resultant force and specify where the resultant's line of action intersects the column AB and boom BC.