

**University of Mumbai**  
**Examination 2020 under cluster 3 (Lead College: FCRIT, VASHI)**

Examinations Commencing from 22<sup>nd</sup> April 2021 to 30<sup>th</sup> April 2021

Program: First Year Engineering

Curriculum Scheme: Rev2019 C Scheme

Examination: FE Semester I

Course Code: FEC101 and Course Name: Engineering Mathematics - I

Time: 2 hour

Max. Marks: 80

<b>Q1.</b>	<b>Choose the correct option for following questions. All the Questions are compulsory and carry equal marks</b>
1.	The value of $\tanh(\log x)$ , if $x = \sqrt{2}$ , will be given by
Option A:	$\sqrt{2}$
Option B:	$\frac{1}{4}$
Option C:	2
Option D:	$\frac{1}{3}$
2.	If $z = e^{i\theta}$ , the value of $z^6 - \frac{1}{z^6}$ will be given by
Option A:	$2i \sin 6\theta$
Option B:	$2 \sin 6\theta$
Option C:	$2 \cos 6\theta$
Option D:	$-2i \sin 6\theta$
3.	The real part of $z = \sqrt{i}$ will be given by
Option A:	1
Option B:	-1
Option C:	$\frac{1}{2}$
Option D:	$\frac{1}{\sqrt{2}}$
4.	Find $x$ , if $5 \sinh x - \cosh x = 5$
Option A:	$x = \log 3$
Option B:	$x = e^3$
Option C:	$x = -\log 3$
Option D:	$x = -3$
5.	Roots of $x^3 - i = 0$ are
Option A:	$e^{\frac{i(2k\pi+\pi)}{6}}$ , $k = 0,1,2$
Option B:	$e^{\frac{i(4k\pi+1)}{6}}$ , $k = 0,1,2$
Option C:	$e^{\frac{i(4k\pi+\pi)}{6}}$ , $k = 0,1,2$
Option D:	$e^{\frac{i(4k\pi+\pi)}{3}}$ , $k = 0,1,2$

6.	What is the value of $\sinh^{-1}(\tan\theta)$
Option A:	$\log\left(\sec\frac{\theta}{2} + \tan\frac{\theta}{2}\right)$
Option B:	$\log(\sec\theta + \tan\theta)$
Option C:	$\log(\sec\theta)$
Option D:	$\log(\cot\theta + \tan\theta)$
7.	If $\tan(x + iy) = i$ , then the value of y is
Option A:	$\log 2$
Option B:	$\frac{1}{4}\log 2$
Option C:	indeterminate
Option D:	$\infty$
8.	Imaginary part of $\text{Log}(3 + 4i)$ is
Option A:	$\tan^{-1}\left(\frac{4}{3}\right)$
Option B:	$\log 5$
Option C:	$\tan^{-1}\left(\frac{4}{3}\right) + 2n\pi$
Option D:	$\tan^{-1}\left(\frac{4}{3}\right) + 2\pi$
9.	If PAQ is in the normal form of A, where A is a non-singular square matrix of order 3, then $A^{-1}$ will be ,
Option A:	PQ
Option B:	QP
Option C:	$Q^{-1}P^{-1}$
Option D:	$P^{-1}Q^{-1}$
10.	The rank of a Unitary matrix of order n is
Option A:	$n - 1$
Option B:	$n + 1$
Option C:	$n$
Option D:	$n + 2$
11.	Find for which value of $\lambda$ and $\mu$ the simultaneous equations $x+y+z = 6$ , $x+2y+3z = 10$ , $x+2y+\lambda z = \mu$ have infinite number of solution
Option A:	$\lambda = 3, \mu = 10$
Option B:	$\lambda \neq 3, \mu = 10$
Option C:	$\lambda = 3, \mu$ can take any value
Option D:	$\lambda = 3, \mu \neq 10$
12.	For which value of $\lambda$ the following system of equations $3x + y - \lambda z = 0$ , $4x - 2y - 3z = 0$ , $2\lambda x + 4y + \lambda z = 0$ have non-trivial solution ?
Option A:	$\lambda \neq -9$ and $\lambda = 1$
Option B:	$\lambda = -9$ and $\lambda = 1$
Option C:	$\lambda = -9$ and $\lambda \neq 1$
Option D:	$\lambda = 9$ and $\lambda = 1$

13.	If $u = e^{\frac{x}{y}}$ , then find the value of $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2}$ is
Option A:	1
Option B:	$\frac{1}{2}$
Option C:	-1
Option D:	0
14.	If $z = f(x,y)$ and $x = uv, y = \frac{u}{v}$ , then the value of $\frac{\partial z}{\partial u}$ will be given by
Option A:	$v \frac{\partial z}{\partial x} - \frac{1}{v} \frac{\partial z}{\partial y}$
Option B:	$\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y}$
Option C:	$v \frac{\partial z}{\partial x} + \frac{1}{v} \frac{\partial z}{\partial y}$
Option D:	$v \frac{\partial z}{\partial x} + u \frac{\partial z}{\partial y}$
15.	If $z = \log r, r = x^2 + y^2$ then find the value of $x \frac{\partial z}{\partial x} + y \frac{\partial z}{\partial y}$
Option A:	-2
Option B:	2
Option C:	2r
Option D:	$\frac{1}{r}$
16.	If $z = \frac{x}{y} + \frac{y}{x}$ , then the value of $\frac{\partial^2 z}{\partial x \partial y}$ is
Option A:	$-\frac{1}{x^2} - \frac{1}{y^2}$
Option B:	$-\frac{1}{x^2}$
Option C:	$-\frac{1}{y^2}$
Option D:	$\frac{1}{x^2} + \frac{1}{y^2}$
17.	If $y = \sin^2 x$ , find $y_{10}$
Option A:	$-2^9 \cos 2x$
Option B:	$2^9 \cos 2x$
Option C:	$2^9 \sin 2x$
Option D:	$-2^9 \sin 2x$
18.	If $y = x^n \log x$ , then $y_{n+1}$ is
Option A:	$n! x$
Option B:	$n! \log x$
Option C:	$\frac{n!}{x}$
Option D:	$n!$

19.	If $(1 + x^2) y_2 = 1$ , then choose the correct option
Option A:	$(1 + x^2) y_{n+2} + 2nx y_{n+1} + n(n - 1)y_n = 0$
Option B:	$y_{n+2} + 2nx y_{n+1} - n(n - 1)y_n = 0$
Option C:	$y_{n+2} - 2nx y_{n+1} + n(n - 1)y_n = 0$
Option D:	$y_{n+2} + 2nx y_{n+1} + n^2 y_n = 0$
20.	The stationary values for $f(x, y) = xy(3 - x - y)$ are
Option A:	$(0,0) , (3,0) , (1,1) , (1,-1)$
Option B:	$(0,0) , (0,3) , (3,0) , (1,1)$
Option C:	$(0,0) , (0,-3) , (3,3) , (1,1)$
Option D:	$(0,0) , (0,-3) , (3,0) , (1,1)$

<b>Q2 . (20 Marks )</b>	<b>Solve any Four out of Six</b>	<b>5 marks each</b>
A	If $\cos 6\theta = a \cos^6\theta + b \cos^4\theta \sin^2\theta + c \cos^2\theta \sin^4\theta + d \sin^6\theta$ , find a,b,c,d.	
B	If $\log \sin(x + iy) = a + ib$ , prove that i) $2e^{2a} = \cosh 2y - \cos 2x$ ii) $\tan b = \cot x \tan hy$	
C	Find the non singular matrices P and Q such that PAQ is in the normal form and hence find Rank of the following matrix $A = \begin{bmatrix} 2 & 1 & 1 & 3 \\ 1 & 0 & 1 & 2 \\ 3 & 1 & 2 & 5 \end{bmatrix}$	
D	Find a,b,c and $A^{-1}$ if $A = \begin{bmatrix} 1 & 2 & a \\ 2 & 1 & b \\ 2 & -2 & c \end{bmatrix}$ is orthogonal.	
E	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.	
F	If $u = f(x^2 - y^2, y^2 - z^2, z^2 - x^2)$ , then prove that $\frac{1}{x} \frac{\partial u}{\partial x} + \frac{1}{y} \frac{\partial u}{\partial y} + \frac{1}{z} \frac{\partial u}{\partial z} = 0$	

<b>Q3. (20 Marks )</b>	<b>Solve any Four out of Six</b>	<b>5 marks each</b>
A	Find the continued product of the roots of $x^4 = 1 + i$	
B	Prove that $2e^{2x} = \cosh 2v - \cos 2u$ , where $e^z = \sin(u + iv)$ and $z = x + iy$	
C	Express the matrix $\begin{bmatrix} 1 + 2i & 2 & 3 - i \\ 2 + 3i & 2i & 1 - 2i \\ 1 + i & 0 & 3 + 2i \end{bmatrix}$ as P+iQ , where both P and Q are Hermitian.	
D	If $x = \cos h \left( \frac{1}{m} \log y \right)$ , then prove that $(x^2 - 1)y_{n+2} + (2n + 1)xy_{n+1} + (n^2 - m^2)y_n = 0$	
E	If $u = \log r$ , and $r^2 = x^2 + y^2$ , then prove that $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} + 1 = 0$	

F	<p>If <math>u = \log \frac{x+y}{\sqrt{x^2+y^2}} + \sin^{-1} \frac{x+y}{\sqrt{x+\sqrt{y}}}</math>, prove that</p> $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = -\frac{\sin w \cos 2w}{4\cos^3 w},$ <p style="text-align: right;">where <math>w = \sin^{-1} \frac{x+y}{\sqrt{x+\sqrt{y}}}</math></p>
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**University of Mumbai**  
**Examination 2020 under cluster 3 (Lead College: FCRIT)**

Examinations Commencing from 22<sup>nd</sup> April 2021 to 30<sup>th</sup> April 2021

Program: FE Sem-I

Curriculum Scheme: Rev2019 C Scheme

Examination: FE Semester I

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

Time: 1.5 hour

Max. Marks: 60

<b>Q1.</b>	<b>Choose the correct option for following questions. All the Questions are compulsory and carry equal marks</b>
1.	Find group velocity of an electron whose de Broglie wavelength is 1.2 AU
Option A:	$6.07 \times 10^8$ m/s,
Option B:	$6.07 \times 10^5$ m/s,
Option C:	$6.07 \times 10^7$ m/s,
Option D:	$6.07 \times 10^6$ m/s
2.	Heisenberg's Uncertainty Principle states that the ___ and ___ of an electron cannot be measured simultaneously with great accuracy.
Option A:	Position, Charge
Option B:	Position, Momentum
Option C:	Position, Time
Option D:	Momentum, Energy
3.	A de Broglie wave will be apparent in macroscopic moving particle
Option A:	True
Option B:	False
Option C:	Sometimes True
Option D:	Sometimes False
4.	An electron is confined to a box of dimension 1 AU. Calculate minimum uncertainty in its velocity.
Option A:	$1.16 \times 10^{-6}$ m/s
Option B:	$1.16 \times 10^3$ m/s
Option C:	$1.16 \times 10^6$ m/s
Option D:	$1.16 \times 10^{-3}$ m/s
5.	Using the wavelength of the X-ray beam that suffers first order Bragg reflection at a glancing angle of $8^\circ 35'$ from a NaCl crystal with lattice spacing 0.282 nm, calculate the maximum order of diffraction possible.
Option A:	6
Option B:	7
Option C:	5
Option D:	8
6.	The ratio of interplanar spacing of (100) : (110) : (111) planes of BCC is
Option A:	$1:1/\sqrt{2} : 1/\sqrt{3}$
Option B:	$1:2/\sqrt{2} : 1/\sqrt{3}$

Option C:	$1:1/\sqrt{2} : 2/\sqrt{3}$
Option D:	$1:2/\sqrt{2} : 2/\sqrt{3}$
7.	Calculate intrinsic carrier density of InSb if its resistivity at room temperature is $2 \times 10^{-4} \Omega\text{-m}$ . If the mobility of electron is $6 \text{ m}^2/\text{V}\text{-sec}$ and mobility of hole is $0.2 \text{ m}^2/\text{V}\text{-sec}$ .
Option A:	$5.04 \times 10^{21}/\text{m}^3$
Option B:	$6.04 \times 10^{21}/\text{m}^3$
Option C:	$7.04 \times 10^{21}/\text{m}^3$
Option D:	$4.04 \times 10^{21}/\text{m}^3$
8.	The layer of positive ions in n type region and layer of negative ions in p type regions is called
Option A:	Barrier Potential
Option B:	Boundary region
Option C:	Junction boundary
Option D:	Depletion region
9.	Match the columns correctly
	(A) (B)
	a) Zener Diode i) Unbiased
	b) LED ii) Reverse Biased
	c) Photovoltaic cell iii) Forward biased
Option A:	a-ii, b-iii, c-i
Option B:	a-i, b-iii, c-ii
Option C:	a-ii, b-i, c-iii
Option D:	a-i, b-ii, c-iii
10.	When junction is formed between p type material and n type material,
Option A:	The Fermi level of p type material is at higher level than Fermi level of n type material
Option B:	The Fermi level of p type material and Fermi level of n type material lie at the same level
Option C:	The Fermi level of n type material is at higher level than Fermi level of p type material
Option D:	The Fermi level of n type material and p type material will not be at the same level.
11.	Find the minimum thickness of the soap film which will appear yellow ( $5896 \text{ \AA}$ ) in reflection when it is exposed by white light at an angle $45^\circ$ . Take $\mu=1.33$ .
Option A:	$2.31 \times 10^{-6} \text{ cm}$
Option B:	$2.31 \times 10^{-5} \text{ cm}$
Option C:	$1.56 \times 10^{-7} \text{ cm}$
Option D:	$1.56 \times 10^{-5} \text{ cm}$
12.	The diameter of 5th dark ring in Newton's rings experiment was found to be 0.42 cm. Determine the diameter of the 10th dark ring.
Option A:	0.594cm

Option B:	0.694cm
Option C:	0.794cm
Option D:	0.494cm
13.	The minimum thickness of antireflection coating is
Option A:	$\lambda / \mu_f$
Option B:	$\lambda / 2\mu_f$
Option C:	$\lambda / 4\mu_f$
Option D:	$\lambda / 8\mu_f$
14.	In Newton's ring experiment when liquid is poured between the glass plate and lens the diameter of the rings
Option A:	decreases
Option B:	increases
Option C:	remains unchanged
Option D:	doubles
15.	Superconductor above critical temperature behaves as
Option A:	Bad conductor
Option B:	Normal conductor
Option C:	Superconductor
Option D:	Semiconductor

<b>Q2.</b> (15 Marks)	<b>Solve any three out of four (5 marks each)</b>
A	Draw the following (030) , (101), (2 1 3) Why is crystal used for X ray diffraction ? State Bragg's law.
B	Newton's rings are formed by light reflected normally from a plano convex lens and a plane glass plate with liquid between them. The diameter of $n^{\text{th}}$ ring is 2.18 mm and that of $(n+10)^{\text{th}}$ ring is 4.51 mm. Calculate the RI of the liquid, given that the radius of curvature of the lens is 90 cm and wavelength of light is $5893 \text{ \AA}$ .
C	In a Hall effect setup a n-type Ge sample with donor concentration $2.5 \times 10^{21} / \text{m}^3$ is used. If the magnetic field is $0.5 \text{ wb/m}^2$ , the current density is $500 \text{ A/m}^2$ and the width of the sample is 4 mm, find the Hall voltage.
D	What is wave group? How does the concept of wave group leads to uncertainty?

<b>Q3.</b> (15 Marks)	<b>Solve any three out of four (5 marks each)</b>
A	Why do coated lenses appear violet in colour? Interference fringes are produced by monochromatic light falling normally on a wedge shaped film of cellophane whose RI is 1.4. The angle of wedge is 20 seconds of an arc and the distance between successive bright fringes is 0.25 mm. Calculate the wavelength of light.
B	Write the boundary conditions for an electron moving in one dimensional potential box with infinite height walls at $x=0$ and $x=a$ . An electron is bound in an one dimensional potential well of width $2.5 \text{ \AA}$ , but of infinite height. Find its energy values in the ground state and in first two excited

	state.
C	Explain Meissner's effect with proper diagram. Show that superconductor is perfectly diamagnetic
D	Explain the position of Fermi level in n type semiconductor. What will happen to Fermi level with increase in temperature and increase in impurity concentration Explain using proper diagram.

**University of Mumbai**  
**Examination 2020 under cluster \_3\_ (Lead College: FCRIT)**

Program: First Year Engineering (All Branches)

Curriculum Scheme: Rev 2019 C Scheme

Examination: FE Semester I

Course Code: FEC103 and Course Name: Engineering Chemistry I

Time: 1 ½ hours

Max. Marks 60

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N.B. 1. Attempt all questions

2. Atomic Weights: H=1, C=12, N=14, O=16, Na = 23, Ca = 40, Mg=24, Cl=35.5, S =32, K=39,

Si =28

<b>Q1.</b>	<b>Choose the correct option for following questions. All the Questions are compulsory and carry two marks.</b>
1.	Which of the following is the eutectic composition of Ag-Pb system?
Option A:	2.6% Pb + 97.4% Ag
Option B:	26% Pb + 74 %Ag
Option C:	74 %Pb + 26% Ag
Option D:	97.4% Pb + 2.6% Ag
2.	Which of the following is the magnetic property of NO molecule?
Option A:	Ferromagnetic
Option B:	Paramagnetic
Option C:	Diamagnetic
Option D:	Antiferromagnetic
3.	Which of the following dissolved salt does not contribute to any kind of hardness to the water?
Option A:	KCl
Option B:	Mg(HCO <sub>3</sub> ) <sub>2</sub>
Option C:	CaCl <sub>2</sub>
Option D:	Mg(NO <sub>3</sub> ) <sub>2</sub>
4.	The chemical reaction between which of the following can give Kevlar Polymer?
Option A:	Hexamethylenediamine + adipic acid
Option B:	Ethylene glycol + Adipic acid
Option C:	Terephthalic acid + Ethylene glycol
Option D:	1,4 phenylenediamine + terephthaloyl chloride
5.	‘No two electrons in an atom can have same four sets of quantum number’ is best known as _____.
Option A:	Aufbau Principle
Option B:	Hund’s rule
Option C:	Pauli exclusion principle
Option D:	Mullikan’s principle

6.	Extrusion molding cannot be used for manufacture of which of the following?
Option A:	Insulated electric cables
Option B:	Buckets
Option C:	Pipes
Option D:	Tubes
7.	Which of the following is not aromatic?
Option A:	Naphthalene
Option B:	Pyrrole
Option C:	Benzene
Option D:	Cyclobutadiene
8.	Which of the following is not a thermoplast?
Option A:	Polyethylene
Option B:	Polyvinyl chloride
Option C:	Bakelite
Option D:	PMMA
9.	In Reverse Osmosis the flow of solvent is through semi permeable membrane from-
Option A:	Higher concentration to lower concentration solution
Option B:	Lower concentration to higher concentration solution
Option C:	Equal concentration of solutions.
Option D:	Independent of concentration
10.	Which of the following is the bond order for CO molecule?
Option A:	1
Option B:	2
Option C:	3
Option D:	4
11.	Which of the following is the hybridization of Nitrogen in Pyrrole molecule?
Option A:	sp
Option B:	sp <sup>2</sup>
Option C:	sp <sup>3</sup>
Option D:	sp <sup>2</sup> d
12.	Which of the following is/are the number of component/s for $\text{CaCO}_3 (s) = \text{CaO} (s) + \text{CO}_2 (g)$ ?
Option A:	1
Option B:	2
Option C:	3
Option D:	4
13.	Cation exchanger bed was exhausted after passing 50,000 L of hard water. 200L of 1N HCl was needed for its regeneration. Hardness of the water is closer to which of the following?
Option A:	1000 ppm
Option B:	400 ppm

Option C:	200 ppm
Option D:	100 ppm
14.	Which of the following is an example of conducting polymer?
Option A:	Polyaniline
Option B:	Polyvinyl chloride
Option C:	PMMA
Option D:	Polyethene
15.	Which of the following represents Gibb's reduced phase rule equation?
Option A:	$P+F = C+ 2$
Option B:	$P+F = C-1$
Option C:	$P+F = C-2$
Option D:	$P+F = C+ 1$

<b>Q.2]</b>	<b>Attempt <u>any three</u> from the following.</b>	<b>[5Marks each]</b>
(a)	Draw a neat diagram and explain the ion exchange process of demineralization of hard water.	
(b)	Draw a neat diagram and explain transfer moulding of plastic.	
(c)	Draw and explain phase diagram of the one component water system.	
(d)	Draw and explain the molecular orbital diagram for O <sub>2</sub> molecule. Also calculate its bond order and predict its magnetic property.	
(e)	Hard water sample contains following impurities (in mg/L) Ca (HCO <sub>3</sub> ) <sub>2</sub> = 174    MgSO <sub>4</sub> = 146    Mg(HCO <sub>3</sub> ) <sub>2</sub> = 168 Ca(NO <sub>3</sub> ) <sub>2</sub> = 198    CaCl <sub>2</sub> = 165    SiO <sub>2</sub> = 123    NaNO <sub>3</sub> = 137 Calculate Temporary, Permanent and Total Hardness of the given sample of the water.	

<b>Q.3]</b>	<b>Attempt <u>any three</u> from the following</b>	<b>[5Marks each]</b>
(a)	Explain bonding in Benzene molecule.	
(b)	What is the role played by Plasticizer, Filler and Catalyst in compounding of the plastic?	
(c)	Write a brief note on Electrodialysis process of purification of water.	
(d)	What are the advantages and limitations of the Phase Rule?	
(e)	Sample of polymer consist of total ten molecules. There exist five molecules each having molecular weight of 20,000 units, Three molecules, each having molecular weight of 25,000 units and two molecules, each having molecular weight of 30,000 units. Calculate number and weight average molecular weight of the polymer.	

**University of Mumbai**  
**Examination 2020 under cluster 03 (Lead College: FCRIT)**

Examinations Commencing from 22<sup>nd</sup> April 2021 to 30<sup>th</sup> April 2021

Program: First Year Engineering (All Branches)

Curriculum Scheme: Rev2019 C Scheme

Examination: FE Semester I

Course Code: FEC104 and Course Name: Engineering Mechanics

Time: 2 hour

Max. Marks: 80

<b>Q1.</b>	<b>Choose the correct option for following questions. All the Questions are compulsory and carry equal marks</b>
1.	Equilibrium of a rigid body in statics refers to_____.
Option A:	Balance of forces in static condition
Option B:	Balance of forces and moments in static condition
Option C:	Balance of energy of body
Option D:	Balance of inertia force and inertia moments
2.	Kinematics of rigid body is_____.
Option A:	Study of geometry of motion considering the cause of motion
Option B:	Study of external force acting on it without considering the geometry of motion
Option C:	Study of geometry of motion without considering the cause of motion
Option D:	Finding the reaction forces and the moments at the supports
3.	Resultant of the forces $F_1= 30i +20j$ and $F_2= -20i +10j$ is _____.
Option A:	31.62 N acting along $71.56^\circ$ to the x-axis
Option B:	31.62 N acting along $18.56^\circ$ to the x-axis
Option C:	3100 N acting along $71.56^\circ$ to the x-axis
Option D:	31.62 N acting along $18.43^\circ$ to the x-axis
4.	Pushing or pulling of a vehicle with same magnitude of force along the same line of action is an illustration of _____.
Option A:	Equilibrium
Option B:	Principle of transmissibility
Option C:	Newtons III law
Option D:	Newtons II law
5.	A block of mass 30 kg is kept on a smooth inclined plane of $30^\circ$ and is supported by a force F acting parallel to the plane. The magnitude of force is _____.
Option A:	14.71 N
Option B:	147.15 N
Option C:	300 N
Option D:	150 N
6.	A rod PQ carries three loads of 40N, 70N, and 100 N at 30 mm, 90 mm and 160 mm respectively from point P. Neglecting weight of the rod, the position of resultant is _____away from point P.
Option A:	11.19 mm

Option B:	1.119 mm
Option C:	111.9 mm
Option D:	1119 mm
7.	If the resultant of the two equal forces is equal to either of them, then angle between the forces is _____.
Option A:	$30^\circ$
Option B:	$60^\circ$
Option C:	$90^\circ$
Option D:	$120^\circ$
8.	Ratio of limiting force of friction and normal reaction is _____.
Option A:	Coefficient of friction
Option B:	Angle of friction
Option C:	Sliding friction
Option D:	Coefficient of restitution
9.	The minimum Force required to keep a body of mass 30 kg in equilibrium on an inclined plane ( plane is inclined $30^\circ$ to horizontal), if the coefficient of Friction is 0.2, is ----- . ( Force applied is parallel to inclined plane).
Option A:	198.124 N
Option B:	161.823 N
Option C:	96.176 N
Option D:	147.15 N
10.	A 2 m long ladder rests against a wall and makes an angle $30^\circ$ with the horizontal. At the instant of slipping, the instantaneous center of rotation will be_____.
Option A:	1.732 m from wall and 1m above the floor
Option B:	1.732 m from wall and 4 m above the floor
Option C:	1.732 m from wall and 2 m above the floor
Option D:	1.732 m from wall and 3 m above the floor
11.	When body slides down an inclined surface, the acceleration of body is given by _____.
Option A:	$g$
Option B:	$g \sin\theta$
Option C:	$g \cos\theta$
Option D:	$g \tan\theta$
12.	During the flight of projectile, which of the following remains constant?
Option A:	Angle of projection
Option B:	Horizontal component of velocity
Option C:	Vertical component of velocity
Option D:	Sum of kinetic and potential energy
13.	A particle experiences constant acceleration for 25 s after starting from rest. If it travels a distance of $S_1$ in the first 15 s and distance $S_2$ in the next 10 s then,
Option A:	$S_1 = 1.78 S_2$
Option B:	$S_2 = 1.78 S_1$
Option C:	$S_1 = S_2$

Option D:	$S_2 = \frac{S_1}{0.78}$
14.	A person walks through the sides of a square field. Each side is 15 m long. Find the maximum magnitude of the displacement of the person in any time of interval.
Option A:	15 m
Option B:	$15\sqrt{2}$ m
Option C:	30 m
Option D:	7.5 m
15.	A particle dropped from a tower and it travels a distance of “y” in the first second. The distance travelled in the fourth second is _____.
Option A:	7y
Option B:	3.5y
Option C:	14y
Option D:	y
16.	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
17.	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
18.	A train passes over a 600 m long bridge. If the speed of the train is 30 /s and the train takes 30 s to cross the bridge, the length of the train is_____.
Option A:	900 m
Option B:	600 m
Option C:	150 m
Option D:	300 m
19.	The area under the speed -time graph gives the_____.
Option A:	Change in displacement of the particle
Option B:	Change in Velocity of the particle
Option C:	Acceleration of the particle
Option D:	Momentum of particle
20.	The point at which the total area of a plane figure is assumed to be concentrated is called_____.
Option A:	Centre of gravity
Option B:	Central point
Option C:	Centroid

## Descriptive Section

Q 2	20 Marks
<b>A</b>	<b>Solve any Two from three</b> <span style="float: right;"><b>2x5 = 10 M</b></span>
i.	<p>Locate the centroid of the shaded area shown in the figure below.</p> <div style="text-align: center;"> <p style="text-align: center;">Figure-1</p> </div>
ii.	<p>The guy wire of a pole is anchored by means of a bolt at a point P as shown in figure 2. The force in the wire is 100 kN. Determine (i) the component of the force in the x, y, z directions and (ii) the direction of the force.</p> <div style="text-align: center;"> <p style="text-align: center;">Figure-2</p> </div>
iii.	<p>Figure 3 shows an angle bracket applied with three forces and couple of magnitude 40 N-m at point A.</p> <p>(i) Find resultant of the system of forces.</p> <p>(ii) Locate the position of the line of action of the resultant force with reference to the lines PQ and QR.</p>

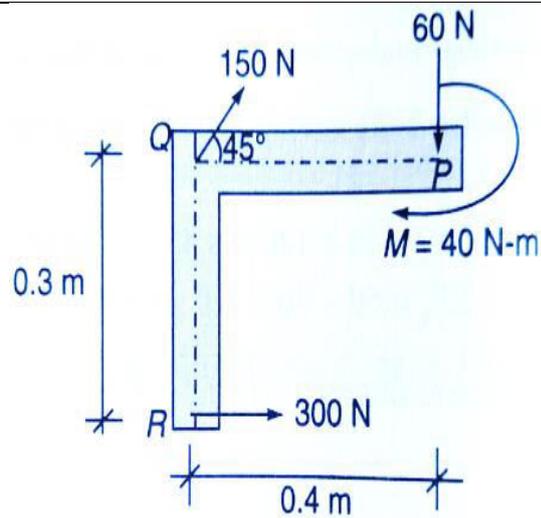


Figure 3

**B Solve any One from the following 10 marks**

**i.** Find the force  $F$  on wedges A and B as shown in Figure 4, necessary to raise the weight of 50 kN acting on block C. Assume that the coefficient of friction between all contact surface is 0.22. The inclination of inclined face of wedge is  $15^\circ$ .

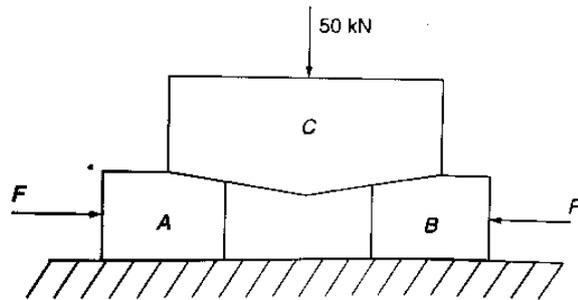
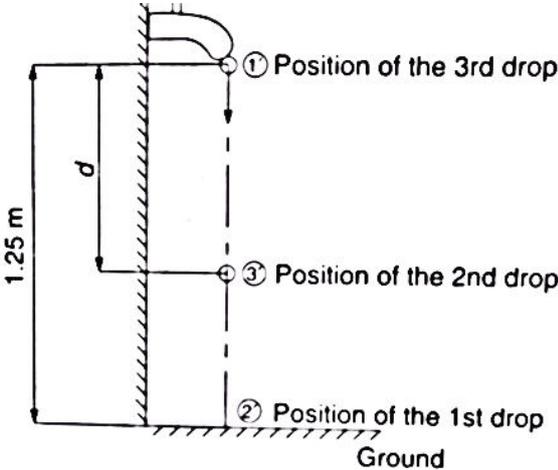
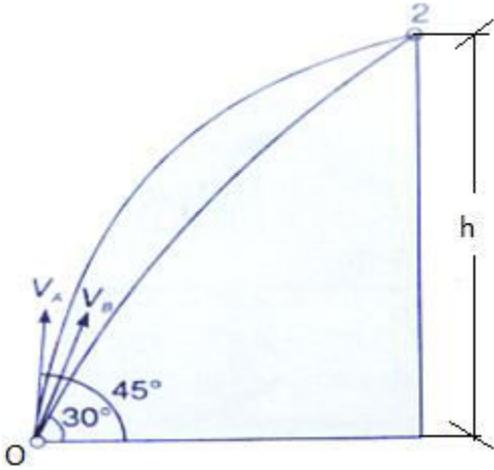


Figure 4

**ii.** Two objects A and B are dropped from the top of a tower of height “ $h$ ” at different time intervals and reach the ground in  $t_1$  seconds and  $t_2$  seconds, respectively. Find the ratio of  $t_1$  and  $t_2$  if the object A travels 50 m in its last second of flight, while object B travels 70 m in its last second of flight?

Q 3	20 Marks
<b>A</b>	<b>Solve any Two out of three from the following 2*5 = 10Marks</b>
i.	<p>Water drops fall at regular interval from a tap which is 1.25 m above the ground. When the third drop leaving the tap, the 1<sup>st</sup> the drop touches the ground. Find the position of the second drop below the tap at that instant.</p>  <p style="text-align: center;">Figure 5</p>
ii.	<p>The motion of particle is defined by the relation <math>x = 3t^3 - 18t^2 + 26t + 8</math>, where <math>x</math> is the position expressed in meters and <math>t</math> is the time in seconds. Determine</p> <p>(i) time when the velocity is zero and</p> <p>(ii) the position and the total distance travelled when the acceleration becomes zero.</p>
iii.	<p>Two stones A and B are projected from the same point at <math>45^\circ</math> and <math>30^\circ</math> respectively, inclined to the horizontal. Find the ratio of the velocities of A and B if the maximum height reached by both is the same. (Refer the figure-6)</p>  <p style="text-align: center;">Figure 6</p>
<b>B</b>	<b>Solve any One 10 marks</b>
i.	<p>A force of 200 N is required to drive a body up an inclined plane of angle <math>15^\circ</math>, the force being parallel to the plane. If the angle of inclination of the plane is made <math>20^\circ</math>, the force required, again parallel to the plane, is found to be 230 N. Find the weight of the body and the coefficient of friction. (Refer Figure-7)</p>

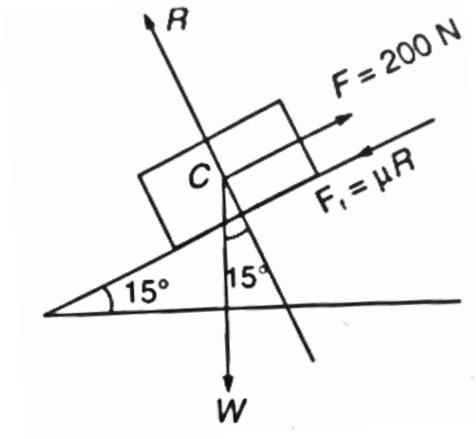


Figure 7

- ii. Figure 8 shows a collar B which moves upwards with a constant velocity of 2 m/sec. At the instant when  $\theta = 40^\circ$ , determine
- the angular velocity of rod AB which is pinned at B and freely resting at A against  $15^\circ$  slopping round
  - the velocity of end A of the rod
  - the velocity of midpoint C of the rod AB.

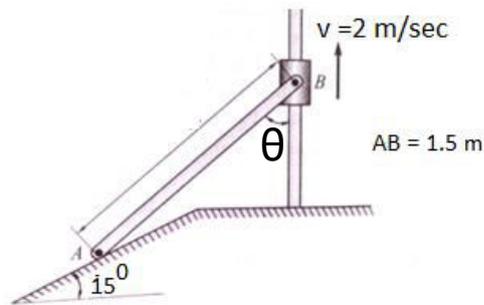


Figure 8

**University of Mumbai**  
**Examination 2020 under Cluster 3 (Lead College: Fr. C. Rodrigues Institute of Technology, Vashi, Navi Mumbai)**

**Examinations Commencing from 22<sup>nd</sup> April 2021 to 30th April 2021**

Program: F.E (All Branches) (Choice Based) (R-2019-20 'C' Scheme)

Curriculum Scheme: Rev 2019 C Scheme

Examination: FE Semester I

Course Code: FEC105 and Course Name: Basic Electrical Engineering

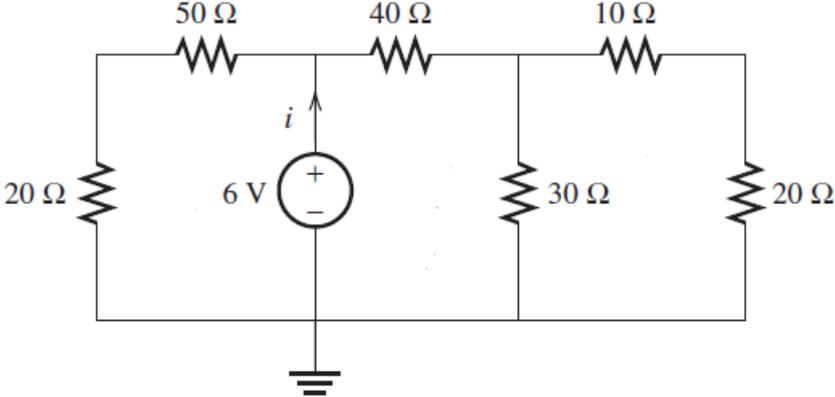
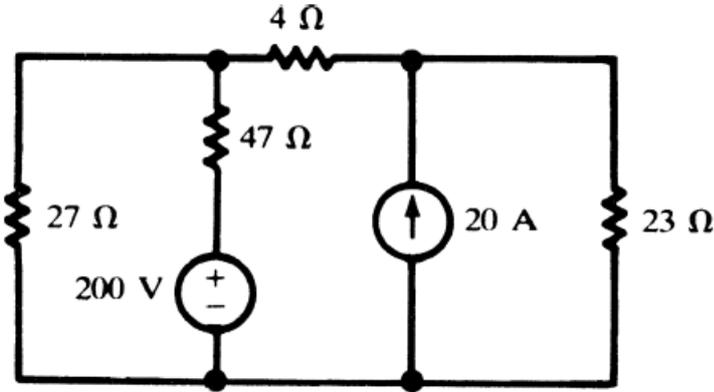
Time: 2 hours

Max. Marks: 80

<b>Q1.</b>	<b>Choose the correct option for following questions. All the Questions are compulsory and carry equal marks</b>
1.	An RLC series circuit is in resonance when
Option A:	Voltage across inductor and voltage across capacitor are different.
Option B:	Inductive reactance is less than capacitive reactance.
Option C:	Inductive reactance is greater than capacitive reactance.
Option D:	Inductive reactance and capacitive reactance are equal.
2.	If open circuit voltage is 18.75 V and the equivalent resistance is 4 Ohms, the maximum power transferred to the load will be
Option A:	21.97W
Option B:	9.36W
Option C:	75W
Option D:	4.68W
3.	Three delta connected resistors absorb 180KW when connected to a three-phase line. If the resistors are connected in star, the power absorbed is
Option A:	540KW
Option B:	90KW
Option C:	60KW
Option D:	180KW
4.	In an R-L-C series circuit, the voltages across the resistor, inductor and capacitor are 12V, 15V and 10V respectively. What is the supply voltage?
Option A:	13V
Option B:	10V
Option C:	5V
Option D:	37V
5.	If a star network has three branches as $R_{an}= 8$ Ohms, $R_{bn}= 3$ Ohms and $R_{cn}= 12$ Ohms, then its equivalent delta circuit will have
Option A:	$R_{ab} = 14$ Ohms, $R_{bc} = 27$ Ohms, $R_{ca} = 28$ Ohms
Option B:	$R_{ab} = 13$ Ohms, $R_{bc} = 19.5$ Ohms, $R_{ca} = 5.2$ Ohms
Option C:	$R_{ab} = 24$ Ohms, $R_{bc} = 36$ Ohms, $R_{ca} = 96$ Ohms
Option D:	$R_{ab} = 13$ Ohms, $R_{bc} = 19.5$ Ohms, $R_{ca} = 52$ Ohms

6.	In a star connected system, current in the line conductor is
Option A:	Equal to the phase current
Option B:	Lesser than the phase current
Option C:	Greater or lower both are possible
Option D:	Greater than the phase current
7.	If R is the resistance of secondary winding of an electrical transformer and K ( $K = N_2/N_1$ ) is the transformation ratio then the equivalent secondary resistance referred to primary will be
Option A:	$R/VK$
Option B:	$R/K^2$
Option C:	$RK^2$
Option D:	$K/R^2$
8.	The equation of 50Hz current sine wave having rms value of 60A is
Option A:	$60 \sin 25t$
Option B:	$60 \sin 50t$
Option C:	$84.85 \sin 314t$
Option D:	$42.42 \sin 314t$
9.	If a voltage source of 5 Volts has an internal resistance of 0.2 Ohms, then its equivalent circuit after source transformation would be
Option A:	5 A current source with 0.2 Ohms connected in series with it
Option B:	5 V voltage source in parallel with 0.2 Ohms
Option C:	25 V voltage source in series with 0.2 Ohms
Option D:	25 A current source in parallel with 0.2 Ohms
10.	An induction motor operates on the basis of interaction between
Option A:	two currents flowing in opposite directions
Option B:	two similar magnetic poles
Option C:	stator and rotor fields
Option D:	three currents flowing in same direction
11.	Voltage division rule and current division rule are applicable to _____ and _____ circuits respectively.
Option A:	Series and Parallel
Option B:	Parallel and Series
Option C:	Series and Series
Option D:	Parallel and Parallel
12.	A transformer has turns ratio $N_1:N_2$ of 6. If a 40 Ohms resistance is connected across the secondary, what is the resistance referred to the primary?
Option A:	240 Ohms
Option B:	1440 Ohms
Option C:	2750 Ohms
Option D:	5.7 KOhms
13.	A coil having a resistance of 15 Ohms and an inductance of 25 mH is connected to a 230 V, 50 Hz supply. Calculate the impedance of the coil and the current flowing through the circuit.

Option A:	16.9 Ohms, 13.6A
Option B:	13.6 Ohms, 16.9 A
Option C:	22.85 Ohms, 10.06A
Option D:	22.85 Ohms, 16.9A
14.	The algebraic sum of the currents meeting at a junction or a node in an electric circuit is
Option A:	infinity
Option B:	dependent on applied voltage
Option C:	zero
Option D:	unity
15.	For an R-C series circuit, current _____ the applied voltage by _____.
Option A:	leads, an angle less than 90 degrees
Option B:	lags, an angle greater than 90 degrees
Option C:	leads, an angle equal to 90 degrees
Option D:	lags, an angle equal to 90 degrees
16.	In a single-phase transformer, the purpose of open circuit test is to determine
Option A:	Equivalent resistance
Option B:	Iron loss
Option C:	Full load copper loss
Option D:	Equivalent reactance
17.	If a current of 8 Amperes flows through a resistor of 5 Ohms which is in series with a parallel combination of 2 Ohms, 2.5 Ohms and 3 Ohms, calculate the current through 2.5 Ohm resistor.
Option A:	2.59A
Option B:	5.2A
Option C:	6.6A
Option D:	1.5A
18.	Slip is expressed as a percentage of
Option A:	Torque
Option B:	Stator speed
Option C:	Synchronous speed
Option D:	Rotor speed
19.	Four resistances of values 5 ohms, 10 ohms, 15 ohms and 20 ohms are connected in series across a 50V source. How is this voltage divided among these resistors?
Option A:	10V, 10V, 20V, 10V
Option B:	5V, 10V, 15V, 20V
Option C:	5V, 5V, 20V, 20V
Option D:	20V, 10V, 10V, 10V
20.	In a linear circuit, the superposition theorem can be applied to calculate the
Option A:	voltage and power
Option B:	current and power
Option C:	power

Q2		
A	Solve any Two	5 marks each
i.	<p>Using mesh analysis find the current 'i' flowing through the 6V source in the circuit shown below:</p> 	
ii.	<p>The resonance frequency of an RLC series circuit is 1200Hz and Q factor is 40. If impedance at resonance is 50 Ohms, find the values of 1) L 2) C 3) bandwidth 4) upper and lower cutoff frequencies.</p>	
iii.	<p>With reference to ac quantities explain the terms: Instantaneous Value, RMS Value, Form Factor, Peak Factor.</p>	
B	Solve any One each	10 marks each
i.	<p>Find the current flowing through the 23 Ohms resistance by applying Superposition Theorem.</p> 	
ii.	<p>The voltage applied to an ac series circuit containing R = 30 Ohms, L = 0.1 H and C = 50 microfarad is 200V, 50 Hz. Find the circuit impedance, circuit current, power factor, active power, reactive power and apparent power.</p>	

<b>Q3.</b>	
<b>A</b>	<b>Solve any Two</b> <span style="float: right;"><b>5 marks each</b></span>
i.	State and explain maximum power transfer theorem.
ii.	The equation of an alternating current is given by $i = 60 \sin 300t$ . Determine 1) maximum value 2) frequency 3) rms value 4) average value 5) form factor.
iii.	How to obtain the approximate equivalent circuit of a transformer as referred to the primary?
<b>B</b>	<b>Solve any One</b> <span style="float: right;"><b>10 marks</b></span> <b>each</b>
i.	Three inductive coils, each with a resistance of 20 Ohms and an inductance of 0.04 H are connected 1) in star and 2) in delta, to a three phase, 400V, 50 Hz supply. Calculate for each of the above case 1) Phase current and Line Current and 2) Total power absorbed.
ii.	The following data were obtained from testing a 5kVA, 200/400V, 50Hz transformer: OC Test (LV side): 200 V            0.7A            70W SC Test (HV side): 22 V            10A            85W Determine the equivalent circuit of the transformer referred to the low voltage side and insert all the parameter values obtained.