ARKAJAIN University
Jharkhand

1st Semester Examination –2021-22

Subject	**Engineering Mathematics**	**Roll No**	.....
Course	**B.Tech ALL**		
Full Marks	**70**	**Time**	**3 Hours.**

Instructions to the Candidates:

- **Read the question paper very carefully.**
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PART A

MULTIPLE CHOICE QUESTIONS (12x1=12)

1. Let A be the square matrix is said to be skew Hermit Ian matrix if
   (a) $A^*=A$ (b) $A^* = -A$ (c) $A^*=A$ (d) None of these

2. $\int_0^{\frac{\pi}{2}} \log sinxdx.$
   a) $\frac{\pi}{8} log2$ b) $-\frac{\pi}{2} log2$ c) $\frac{\pi}{4}$ d) None of these

3. Supremum of the sequence $a_n=\{\frac{1}{2},\frac{2}{3},\frac{3}{4}\ldots\ldots\}$ is
   a) 0 b) $\frac{1}{2}$ c) 1 d) none of these

4. $\int_0^{\frac{\pi}{2}} cos^n xdx$
   a) $\frac{1}{n-1} I_{n-2}$ *b)* $\frac{1}{n-1} - I_{n-2}$ *c)* $\frac{1}{n-1} + I_{n-2}$ d) None of these

5. $\lim_{x\to\infty} \frac{x^n}{e^x}$=?
   a) 1 (b 0 (c 2 (d 4

6. Series a+ar+ar^2+ar^3.....of G.P is convergent if common ratio r is
   a) r>1 b) r<1 c) r= -1 d) none of these

7. The sequence whose nth term is $\frac{2n-7}{3n+2}$ tends to the limit
   a) $\frac{2}{3}$ b) $\frac{1}{3}$ c) $\frac{2}{5}$ d) none of these

8. The expansion of the function f(x) = $e^x sinx$ be

(a) 1-x+$\frac{x^2}{2!}-\frac{x^3}{3!}\cdots\cdots$ (b) 1-x-$\frac{x^2}{2!}-\frac{x^3}{3!}\cdots\cdots$ (c) x+2$\frac{x^2}{2!}+2\frac{x^3}{3!}\cdots\cdots$ (d) None of these

9 $\lim_{x\to 0}\frac{xlogx}{1-cosx}$=?

(a) 1 (b) 2 (c) 0 (d) -1

10. Let $\{a_n\}$ is called strictly monotonic increasing sequence if

(a) $a_n<a_{n+1}$ (b) $a_n>a_{n+1}$ (c) $a_n\leq a_{n+1}$ (d) None of these

11. $\Gamma n+1$ =?

(a n! (b n (c (n+1)! (d None of these

12. Divergence of a vector function $\vec{V}(x,y,z)$is

(a Scalar quantity (b Vector quantity (c Not defined (d None of these

PART B

ANSWER ANY FOUR OUT OF SIX **(4x7=28)**

1. if u= $\sin^{-1}\frac{x^2+y^2}{x-y}$,prove that x$\frac{\partial u}{\partial x}$ +y$\frac{\partial u}{\partial y}$ = tanu
2. Test the convergence whose nth term is $\frac{1}{(1+\frac{1}{n})^{n^2}}$
3. Using lag ranges mean value theorem find a point on the curve $y=x^2$ where the tangent is parallel to the line joining the points (1, 1) and (2, 2)
4. Find the rank of the matrix A=$\begin{bmatrix}1 & 2 & 3\\ 1 & 4 & 2\\ 2 & 6 & 5\end{bmatrix}$.
5. Test the convergence of the series $1+\frac{1+2}{1+2^2}+\frac{1+3}{1+3^2}+\frac{1+4}{1+4^2}+\cdots\frac{1+n}{1+n^2}+\cdots to\ \infty$
5. A particle moves along the curve x=4cost, y=4sint, z=6t. Find the velocity and acceleration at time t=0 and t=$\frac{\pi}{2}$
6 find the unit vector normal to the surface $z= x^2+y^2$ at a point (-1,-2,-5)

ANSWER ANY TWO OUT OF FOUR **(2x15=30)**

1. Investigate for what values for λ and μ the simultaneous equations

   X+y+z=6

   X+2y+3z=10

   X+2y+$\lambda z=\mu$ have (i) no solution (ii) a unique solution (iii) an infinite no of solutions
2. Show that the radius of the curvature at any point of the cycloid x=a (t+sint), y=a (1-cost) is 4acost/2.
3. Discuss the convergence and divergence of Series a+ar+ar^2+ar^3……..to ∞ which is series in G.P.
4. If $\vec{r}=\vec{a}coswt+\vec{b}sinwt$ show that (i) $\vec{r}\times\frac{d\vec{r}}{dt}=w\vec{a}\times\vec{b}$ (ii) $\frac{d^2\vec{r}}{dt^2}$= $-w^2\vec{r}$

ARKAJAIN University
Jharkhand

1ST Semester Examination –2021-22

Subject	**: Engineering Mechanics**	**Roll No**	**: .....**
Course	**: B.Tech. All**		
Full Marks	**: 70**	**Time**	**: 3 Hours.**

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PART A

MULTIPLE CHOICE QUESTIONS **(12x1=12)**

1. Effect of a force on a body depends upon

a. Magnitude b. Direction c. Line of action d. All of these

2. Static equilibrium of a body refers to the condition when

a. Total resultant is zero b. Resultant of any direction is zero

c. There are no unbalanced forces d. All of these

3. According to principle of transmissibility of forces, the effect of a force upon a body is

a. Maximum when it acts at the center of gravity of a body
b. Different at different points in its line of action
c. The same at every point in its line of action
d. None of these.

4. A heavy ladder resting on floor and against vertical wall may not be in equilibrium, if a. Floor is smooth, wall is rough b. Floor is rough and wall is smooth

c. Floor and wall, both are smooth d. Floor and wall, both are rough

5. In Columba's friction, the frictional force depends on

a. Area of surface b. Relative velocity c. Normal force d. All of these

6. The resultant of two forces, one of which is double the other is 260N. If the direction of the larger force is reversed and the other remain unaltered, the magnitude of the resultant reduces to 180N. Then the magnitude of the forces and the angle between the forces will be

a. 100N, 200N, 45° b. 100N, 200N, 63.9° c. 50N, 100N, 63.9° d. 50N, 100N, 45°

7. The coefficient of static friction is _____

a. Less than the coefficient of kinetic friction
b. Greater than the coefficient of limiting friction
c. Equal to the coefficient of kinetic friction
d. Equal to the tangent of the angle of friction

8. Twisting moment is also called as _____

a. Moment of line b. Moment of section
c. Moment of plane d. Torsional moment

9. A truss in which all the members lie in a single plane is called

a. Rigid truss b. Over-rigid truss c. Plane truss d. Under-rigid truss

10. Units of U.D.L?

a. KN/m b. KN-m c. KN-m×m d. KN

11. The loading generally act upon the _____ of the body.

a. Centroid b. Symmetrical center c. Rotational center d. chiral center

12. Which of the following needs to zero for the perfect equilibrium for the calculation of the work?

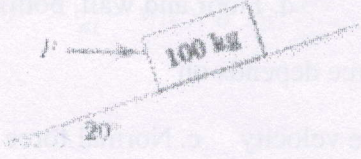
a. $\sum F=0, \sum M=0$ and $\sum \theta = 0$ b. $\sum F=0, \sum M\neq 0$ and $\sum \theta = 0$

c. $\sum F\neq 0, \sum M=0$ and $\sum \theta = 0$ d. $\sum F=0, \sum M=0$ and $\sum \theta \neq 0$

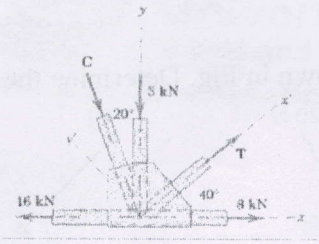
PART B

ANSWER ANY FOUR OUT OF SIX **(4 x 7 = 28)**

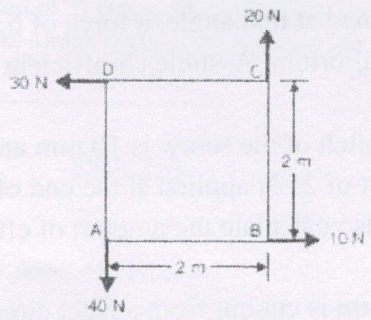
1. Determine the magnitude and direction of the friction force acting on the 100-kg block shown if, first, P= 500 N and, second, P= 100 N. The coefficient of static friction is 0.20, and the coefficient of kinetic friction is 0.17. The forces are applied with the block initially at rest.



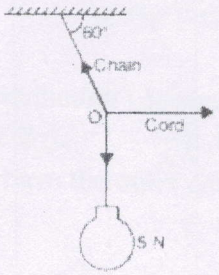
2. Determine the magnitudes of the forces C and T, which, along with the other three forces shown, act on the bridge-truss joint.



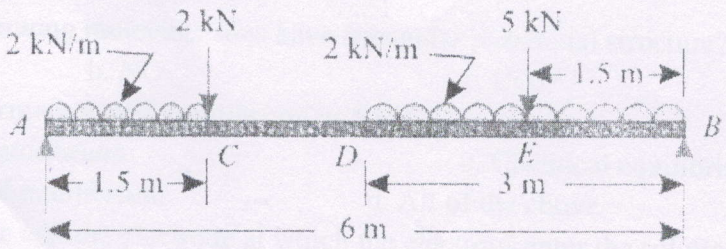
3. Three collinear horizontal forces of magnitude 200 N, 100 N and 300 N are acting on a rigid body. Determine the resultant of the forces when
   (i) All the forces are acting in the same direction,
   (ii) The force 100 N acts in the opposite direction.
4. Four forces of magnitude 10 N, 20 N, 30 N and 40 N are acting respectively along the four sides of a square ABCD as shown in Fig. Determine the resultant moment about the point A. Each side of the square is given 2 m.



5. A lamp weighing 5 N is suspended from the ceiling by a chain. It is pulled aside by a horizontal cord until the chain makes an angle of 60° with the ceiling. Find the tensions in the chain and the cord by applying Lami's theorem



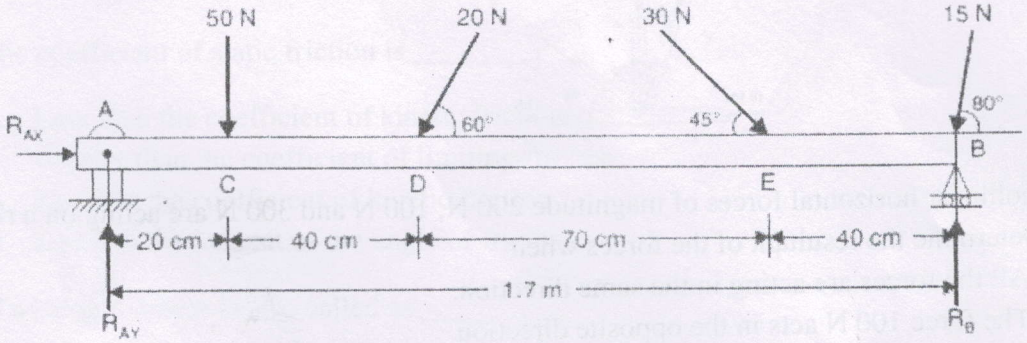
6. A simply supported beam AB of span 6 m is loaded as shown in Fig. Determine the reactions at A and B.



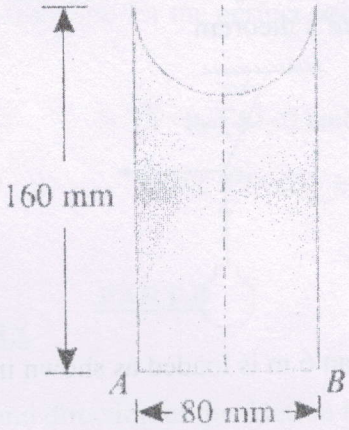
PART C

ANSWER ANY TWO OUT OF FOUR **(2x15=30)**

1. A beam AB 1.7 m long is loaded as shown in Fig. Determine the reactions at A and B.



2. Find the force required to move a load of 30 N up a rough inclined plane, the force being applied parallel to the plane. The inclination of the plane is such that when the same body is kept on a perfectly smooth plane inclined at that angle, a force of 6 N applied at an inclination of 30° to the plane keeps the same in equilibrium. Assume co-efficient of friction between the rough plane and the load is equal to 0.3.
3. In a simple screw jack, the pitch of the screw is 10 mm and length of the handle is 450 mm. Find the velocity ratio. If an effort of 25 N applied at the end of the handle can lift a load of 3 kN, find the efficiency of the jack. Also calculate the amount of effort wasted in friction and the frictional load.
4. A hemisphere of radius 80 mm is cut out from a right circular cylinder of diameter 80 mm and height 160 mm as shown in Fig. 6.33. Find the center of gravity of the body from the base AB.



ARKAJAIN University
Jharkhand

1st Semester Examination –2021-22

Subject	**: Engineering Chemistry**	**Roll No**	**: .....**
Course	**: B.TECH (All Branch)**		
Full Marks	**: 70**	**Time**	**: 3 Hours.**

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PART A

MULTIPLE CHOICE QUESTIONS (12x1=12)

a. Which among the following species does not exist

a. He_2 b. Be_2 c. Ne_2 d All

b. Arrange the following molecules in decreasing bond length.

a. $O_2 > O_2^- > O_2^+ > O_2^{2-}$ b. $O_2^{2-} > O_2^- > O_2 > O_2^+$

b. c. $O_2^{2-} > O_2^- > O_2^+ > O_2$ d. $O_2^- > O_2^+ > O_2^{2-} > O_2$

c. The crystal field splitting energy for octahedral (Δo) and tetrahedral complexes (Δt) are related as

a. $\Delta_o = 2\,\Delta_t$ b. $\Delta_t = 1/2\,\Delta_o$ c. $\Delta_t = 4/9\,\Delta_o$ d. $\Delta_o = 4/9\,\Delta_t$

d. Which of the following elements will have the outer electronic configuration $(n-1)d^5\,ns^1$

a. Cr b. Cu c. Ar d. Na

5. The atom having maximum electron gain enthalpy is

a. F b. Cl c. Br d. I

6. Which of the following molecule/ ions have triangular pyramidal structure?

a. H_3O^+ b. NO_3^- c. CO_3^{2-} d. BF_3

7. A system in thermodynamic equilibrium will be in

a. Thermal equilibrium c. Chemical equilibrium

b. Mechanical equilibrium d. All of the above

8. In an electrolytic cell the electrode at which the electrons enter the solution is called the _____; the `chemical change that occurs at this electrode is called _____.

a. Anode, oxidation
b. Cathode, oxidation
c. Anode, reduction
d. Cathode, reduction

9. Vinyl chloride is the monomer of
a. Polythene b. Pvc c. Polystyrene d. Bakelite

10. σ- σ* transitions will not be observed in the UV spectra of the following compounds.
a. Alkanes b. Azo compounds c. Cyanides d. Alcohol

11. The distance between the two adjacent crests or troughs of a wave is called its
a. Frequency b. Wavelength c. Wave number d. Velocity

12. Infrared spectroscopy provides valuable information about
a. Molecular weight b. Melting point c. Conjugation d. **functional groups**

PART B

ANSWER ANY FOUR OUT OF SIX **(4x7=28)**

1. What are the basic postulates of molecular orbital theory in explaining the bonding between atoms? Is O_2 molecule is paramagnetic or diamagnetic? Discuss.
2. Explain the principle of NMR spectroscopy. What is meant by term chemical shift? Explain how the NMR spectrum of a compound is recorded with example.
3. State and explain the second law of thermodynamics. Explain the term entropy. Predict the nature of process for which (a) ΔH and ΔS are positive and (b) $\Delta H>0$ and $\Delta S<0$.
4. Explain the example H_2O, H_3O^+ and SF_4, the role of lone pair of electrons in determining the shape of the molecules.
5. Write the general outer electronic configuration of s, p, d and f block elements. Explain the general properties of elements belonging to these groups.
6. Explain different primary water treatment with the help of suitable diagram.

PART C

ANSWER ANY TWO OUT OF FOUR **(2x15=30)**

1. Write the electronic configuration, energy level diagram, calculate the bond order and predict the magnetic behavior of : N_2, N_2^+, N_2^-, N_2^{2-}.
2. What is meant by corrosion? What do you understand by dry corrosion and wet corrosion? State their distinguishing features. Describe the properties of metal that effect the rate of corrosion.
3. What are polymers? What are the different criteria for their classification? Discuss the mechanism for addition and condensation polymerization with a suitable example.
4. Write down the basic postulates of crystal field theory. Explain CFT for octahedral complex. Explain the distribution of electrons in the presence of strong field and weak field ligands for a central atom having d^4, d^5, d^6 and d^7 electrons, respectively.

ARKAJAIN University
Jharkhand

1ST Semester Examination –2021-22

Subject	**: Basic Electrical Engineering**	**Roll No.**	**:**
Course	**: B.Tech All**		
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PART A

MULTIPLE CHOICE QUESTIONS **(12x1=12)**

1. Which of the following elements of electrical engineering cannot be analyzed using Ohm's law?
   a) Capacitors b) Inductors c) Transistors d) Resistance

2. How many cycles will an AC signal make in 2 seconds if its frequency is 100 Hz?
   a) 50 b) 100 c) 150 d) 200

3. Resonant frequency of an ac series circuit is:
   (a $1/2\pi(LC)^{1/2}$ (b$1/4\pi(LC)^{1/2}$ (c $1/4\pi LC$ (d $1/2\pi LC$

4. Which of the following is correct about the power consumed by R_1 and R_2 connected in series if the value of R_1 is greater than R_2?
   a) R_1 will consume more power
   b) R_2 will consume more power
   c) R_1 and R_2 will consume the same power
   d) The relationship between the power consumed cannot be established

5. What is the number of primary turns in a 200/1000 V transformer if the emf per turn is 10V?
   a) 5 b) 10 c) 20 d) 40

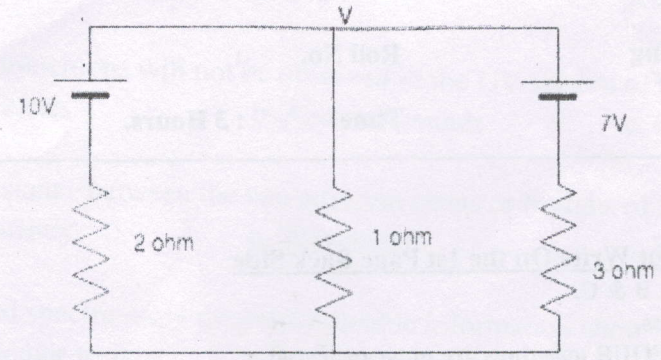
6. The nodal analysis is primarily based on the application of
   a) KVL b) KCL c) Ohm's law d) Both b and c

7. Which of the following is a correct representation of average value in an AC Circuit?
   a) RMS value/Form factor b) RMS value*Form factor
   c) RMS value/Peak factor d) RMS value*Peak factor

8. What is the magnitude of mutually induced emf, E_2 in a transformer?
   a) directly proportional to rate of change of flux and number of secondary turns

b) inversely proportional to rate of change of flux and number of secondary turns
c) proportional to rate of change of flux and inversely proportional to number of secondary turns
d) inversely proportional to rate of change of flux and proportional to number of secondary turns

9. Find the node voltage V.



a) 1V b) 2V c) 3V d) 4V

10. Which of the following type of circuits in electrical engineering cannot be analyzed using Ohm's law?
a) Unilateral b) Bilateral c) Linear d) Conductors

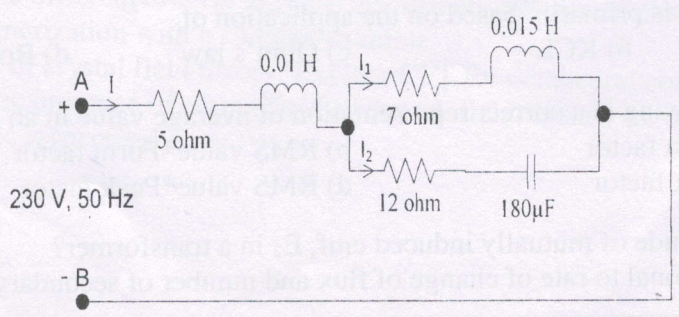
11. Under no load condition which of the following loss is negligible?
a) Hysteresis loss b) Eddy current loss c) Copper loss d) All losses

12. What is the equivalent resistance of the primary of a transformer with a voltage transformation ratio of 10 and primary resistance of 0.05Ω when referred to secondary?
a) 0.005 b) 0.5 c) 5 d) 50

PART B

ANSWER ANY FOUR OUT OF SIX **(4x7=28)**

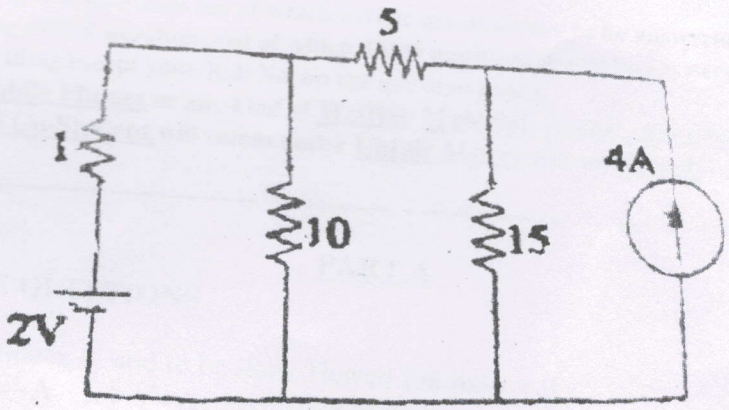
1. Derive a relation for voltage and current in three phase star connection and draw its phasor diagram.
2. Define and explain in detail hysteresis with a diagram.
3. Derive a relation for current voltage and power in RL and RLC single phase AC circuit.
4. What is a transformer? Discuss with diagram step-down and auto transformer.
5. Use nodal analysis method to find currents in resistors of the circuit given below.
6. Derive the emf equation of a dc generator. Discuss about the different types of excitation of dc generator showing electrical circuit diagram and governing loop and KCL equations.
7. In the ac circuit shown in the given fig, find the (i) total impedance (ii) total current and overall power factor (iii) current in each branch (iv) volt ampere (v) Active power
8. (vi) Reactive volt ampere.



PART C

ANSWER ANY TWO OUT OF FOUR **(2x15=30)**

1. Draw and discuss the 3 phase transformer connection of the following:
   (A) Delta- Delta (B)Star- Delta (C) Delta- Star
2. What is a three phase induction motor? With a diagram explain in detail its working principle. Consider both squirrel cage type rotor and slip ring type rotor.
3. A voltage of $250\angle 0^0$ applied to an inductive circuit of impedance (5+j10) Ω.
   Calculate (a) the circuit current (b) the power factor (c) the power consumption
   (d) the apparent power (e) the reactive power
4. A 6 pole, 50 Hz 3 ϕ induction motor running on full load develops a useful torque of 150 Nm at a rotor frequency of 1.5 Hz. Calculate the shaft power output. If the mechanical torque lost in friction be 10 Nm, determine (a) rotor copper loss, (b) the input to the motor, and (c) the efficiency. The total stator loss is 700 W A Determine the current in 20 ohm resistor of the network in the circuit by the venin's.



B. Solve for the power delivered to the 10 ohm resistor in the circuit shown below. All *resistance are in ohm*