

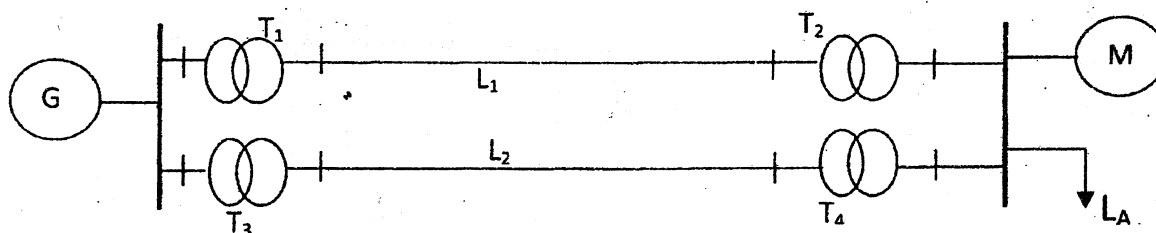
Examination Control Division
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Power System (EE553)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
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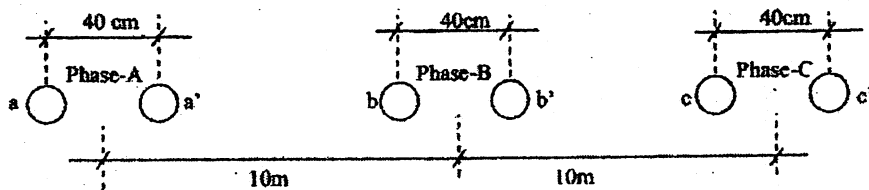
1. a) Give the reasons for the following in brief: [8]
 - i) Necessity of higher voltage for transmission of electric power.
 - ii) Advantage of 3-phase transmission and distribution
 - iii) Popularity of A.C. application in power system.
 - iv) Interconnecting of several generators in parallel
- b) A transmission line conductor having a distance of 19 mm weighs 0.82 kg/m. The span is 250 m. The wind pressure is 39 kg/m² of projected area and with ice coating of 12 mm. The ultimate strength of conductor is 8000 kg. Calculate the maximum sag if the factor of safety is 2.5 and ice weighs 900 kg/m³. [8]
2. a) How are the faults in underground cables located? Describe one of the methods with necessary figures. [6]
- b) Why transposition is required in three-phase line with un-symmetrical spacing? [4]
- c) Explain impedance protection scheme applied for the protection of transmission line. [6]
3. a) The single line diagram of a 3- ϕ system is shown in figure below and corresponding ratings are described. Select the common base of 100MVA and 22 kV on the generator side. Draw an impedance diagram with all the impedances marked in p.u. The 3- ϕ load (L_A) is 57 MVA, 0.6(lag) power factor at 10.45 kV. Lines L_1 and L_2 have reactance of 48.4 Ω , 65.43 Ω respectively. [8]



G:	90 MVA	22 kV	reactance 18%
T ₁ :	50 MVA	22/220 kV	reactance 10%
T ₂ :	40 MVA	220/11 kV	reactance 6%
T ₃ :	40 MVA	22/110 kV	reactance 6.4%
T ₄ :	40 MVA	110/11 kV	reactance 8%
M:	66.5 MVA	10.45 kV	reactance 8.5%

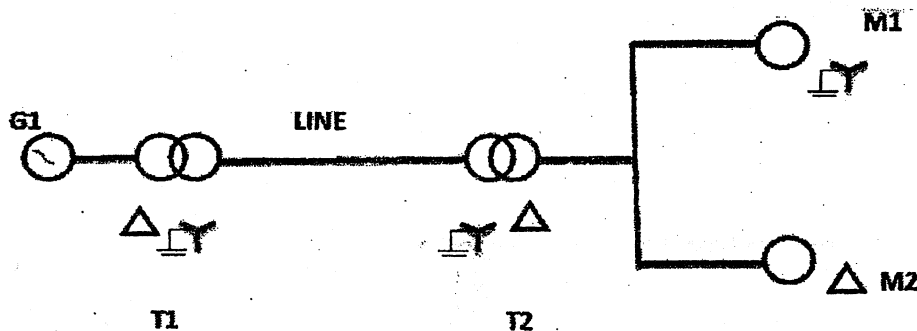
- b) Calculate the inductance and capacitance per phase per km of a three-phase transmission line with bundle conductor as shown in figure below: Given that radius of each conductor is 9 mm and the line is transposed.

[8]



4. a) A 90 MVA 11 kv 3-phase generator has a reactance of 25%. The Generator supplies 2 motors through transformers and transmission line as shown in figure below. The transformer T1 is a 3-phase, 100 MVA, 10/132 kV, 6% reactance. The transformer T2 is composed of 3 single phase units each rated at 30 MVA, 66/10 kV with 5% reactance. The connection of T1 and T2 are as shown in figure below. The motors are rated at 50 MVA and 40 MVA both 10 kV and 20% reactance. Taking the generator rating as base, draw reactance diagram and indicate the reactance in pu. The reactance of the line is 100 ohms. Generator neutral is also grounded.

[8]



- b) A 3-phase 220 kV, 50 Hz transmission line supply the power of 100 MW at power factors of 0.8 lagging. If the line has following ABCD parameters.

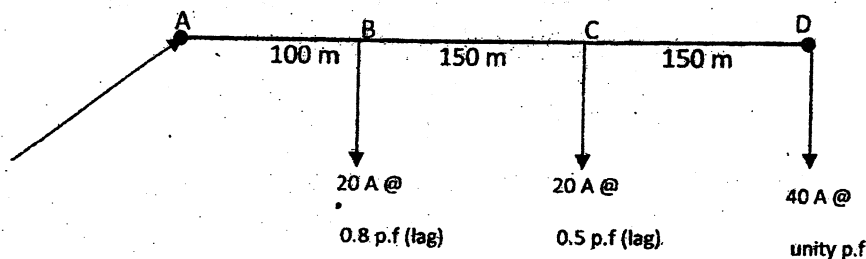
[8]

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 0.9 \angle 0.01 & B \\ 0.00114 \angle 90 & 0.9 \angle 0.001 \end{bmatrix}$$

Determine the following:

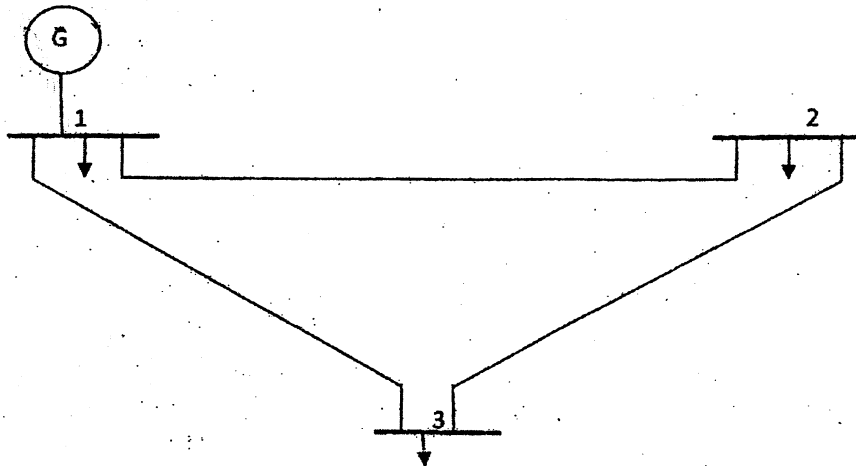
- Sending end voltage
 - No-load receiving end voltage
 - Real and reactive power at sending at full load
 - Real and reactive power loss in the line at full load
 - Voltage regulation and line efficiency at full load
5. a) The loading on a distributor is shown in figure below. The distributor is a two-core cable for which the resistance and reactance are 0.25Ω and 0.125Ω per km of cable run respectively. What should be the voltage at the point A to maintain 400V at point D?

[6]



- b) Use Gauss Seidal Method to obtain unknowns for the following data set (all values are in p.u) referring to the 3-bus, 3-line system as shown in figure below. Iterate only two steps. The range of Q_2 is in between 0.01 p.u to 1 p.u. Assume each line to have series impedance of $0.8+j0.2$ p.u and a shunt admittance of 0.04 p.u.

[10]



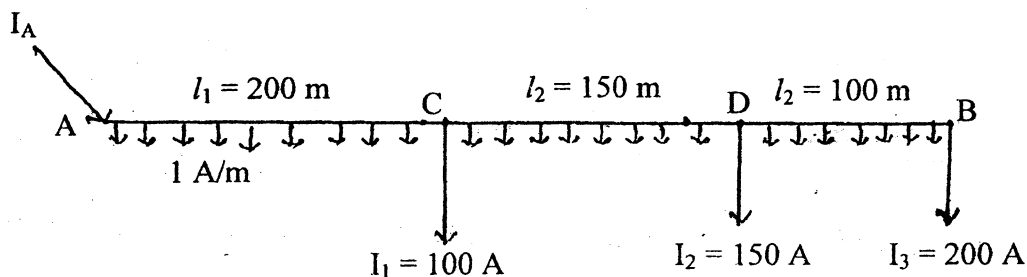
Bus No.	P_0	Q_0	P_G	Q_G	V	Bus type
1	1.0	0.75	?	?	$1.05+j0$	Slack
2	0.5	1.0	0	0	?	PQ bus
3	1.2	0.5	0	?	$ 1.02 $	PV bus

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1. a) What are the advantages of HVDC over HVAC transmission line? Draw neat single line diagram for representation of power system. [4+4]
- b) A transmission line has a span of 180 m between level supports. Line conductor has a cross-sectional area of 1.2 cm^2 and it weighs 1 kg/m . Calculate the maximum sag in a wind pressure of 33.5 kg/m^2 of the projected area of the ice covered line. The radial thickness of the ice is 1.3 cm. Assume that the maximum stress in the line is not to increase one fifth of the ultimate strength of 4200 kg/cm^2 . [6]
- c) What are the different types of cable faults? Explain to find the location of earth fault in cable. [2+4]
2. a) What is skin effect and proximity effect in transmission line? [2+2]
- b) Derive an expression for inductance of transmission line with unsymmetrical spacing. [4]
- c) A 220 KV, 50 Hz, 200 km long 3 phase line has its conductors at the corners of a triangle with sides 6m, 6 m and 12 m. The conductor radius 1.75 cm. Find the capacitance per phase per km, charging current and total charging MVAR. [8]
3. a) What do you understand by Surge Impedance Loading (SIL)? [2]
- b) Show base impedance in case of 3-phase with 3-phase MVA and line to line voltage as base quantities is same as that of phase voltage and per phase MVA base. [4]
- c) A 12 km long 3-phase overhead line delivers 6 MW at 11 KV at power factor of 0.8 lagging. Line loss is 10% of the power delivered. Line inductance is 1.2 mH per km per phase. Calculate sending end voltage and regulation. [6]
4. a) Classify different types of bus in used in load flow. Explain real power/frequency balance with neat diagram. [2+6]
- b) What is primary and secondary distribution system? [4]
- c) The dc distributor is loaded as under: $I_1 = 100 \text{ A}$, $I_2 = 150 \text{ A}$, $I_3 = 200 \text{ A}$. The lengths $l_1 = 200 \text{ m}$, $l_2 = 150 \text{ m}$ and $l_3 = 100 \text{ m}$. The resistance of both conductors is $0.1 \Omega / \text{km}$. The distributor supplies a distributed load of 1 A/m in addition to concentrated loads. Find the voltage at points C, D and B if $V_A = 200 \text{ V}$. [8]



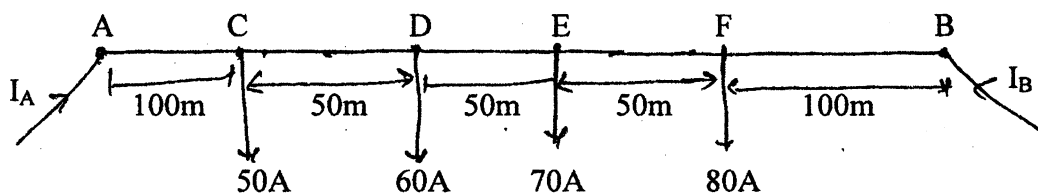
5. a) Write down the differences of fuse and circuit breaker? [6]
- b) Explain basic protection scheme for transformer. [6]

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1. a) Explain the generation, transmission and distribution components of a power system with the help of single line diagram. [6]
- b) An overhead transmission line at a river crossing is supported from two towers at height of 25m and 75m above the water level. The horizontal distance between the towers is 250m. If the required clearance between the conductor and the water, midway between the tower is 45m and if both the towers are on the same side of the point of maximum sag, find the stringing tension in the conductor, the weight of the conductor is 0.8 kg/m. [10]
2. a) What is insulation resistance of a cable also show that it varies inversely to the length of cable. $R = \frac{\rho l}{A}$ [1+3]
- b) List out the advantages and application of per unit system in the power system analysis. [4]
- c) A 300 km, 132 kV 3- ϕ overhead line has a total series impedance of $(52 + j200)\Omega$ per phase and a total shunt admittance of $j1.5 \times 10^{-3}$ Siemen per phase. The line is supplying 40 MVA at 0.8 pf lagging at 132 kV. Find sending end voltage, current, power factor and power using nominal π -model. [4 \times 2]
3. a) Derive the expression for inductance of a line due to internal flux linkage. [6]
- b) A 220 kV, 50 Hz 200 km long 3- ϕ transmission line has its conductor place in horizontal configuration with spacing between adjacent conductor as: 6m, 6m and 12m. The conductor radius is 1.81 cm. Find the capacitance per phase per kilometer, capacitive reactance per phase, charging current and total charging MVAR of the line. [10]
4. a) Derive the basic load flow equation for a general "N" Bus interconnected power system. [6]
- b) A DC distributor AB is fed from both ends. At feeding point A, the voltage is maintained at 235 V and at B it is 240 V. The total length of the feeder is 200 meter and loads are tapped as under in the figure. The resistance of one conductor is 0.4 Ω /km. Calculate the currents in various section of the feeder, the minimum voltage and the point at which it occurs in the system. [10]



5. a) Explain the different types of power system faults. [6]
- b) What is the function of circuit breaker and explain its operation. [6]
- c) Explain differential protection for a transformer. [4]

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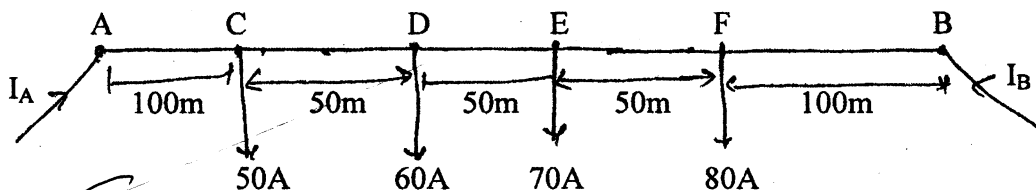
c) A 300 km, 132 kV 3- ϕ overhead line has a total series impedance of $(52 + j200)\Omega$ per phase and a total shunt admittance of $j1.5 \times 10^{-3}$ Siemen per phase. The line is supplying 40 MVA at 0.8 pf lagging at 132 kV. Find sending end voltage, current, power factor and power using nominal π -model. [4 \times 2]

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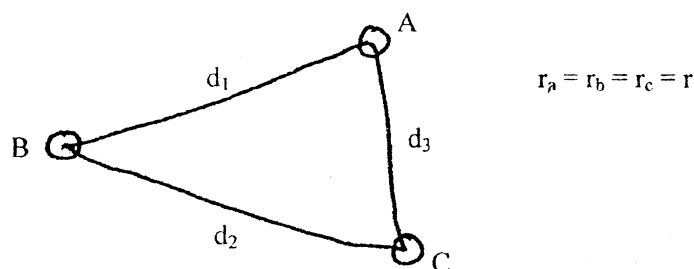
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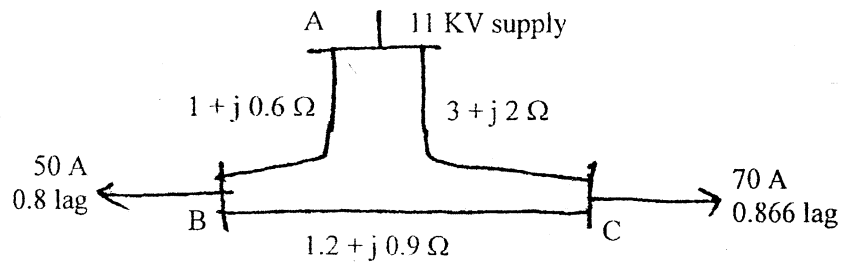
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1. Why ac system is more popular than dc system. Explain with mathematical expression. [8]
2. A transmission line conductor having a diameter of 19.5 mm weighs 0.85 kg/m. The span is 275 m, and wind pressure of 39 kg/m² is applied to the projected area with ice coating of 13 mm. The ultimate strength of the conductor is 8000 kg. Calculate the maximum sag if the factor of safety is 2 and ice weighs 910 kg/m². [6]
3. Discuss the application of G.P.S. system in power system. [6]
4. Derive an expression for the calculation of inductance/phase/km of the transposed line with following configuration. [8]



5. What do you mean by GMD and GMR? Explain how the value of GMR differs in calculating the inductance and capacitance. [8]
6. What are the methods of compensating the reactive power in transmission lines? [4]
7. A single phase 50 Hz generator supplies an inductive load of 5 MW at a power factor of 0.707 lagging by mean of an overhead transmission line 20 km long. The resistance and the inductance of the line are respectively 0.0195 ohm and 0.63 mH per km. The voltage at the receiving end is required to be kept constant at 10 kV. Find [8]
 - i) The sending end voltage and the voltage regulation of the line;
 - ii) The value of capacitance to be placed in parallel with the load such that the regulation is reduced to 50% of (i)
 - iii) Compare the efficiencies of the line in parts (i) and (ii)
8. How real power/frequency and reactive power/voltage balanced is maintained in power system. Explain with suitable mathematical expression. [8]

9. For a distribution network shown below, calculate the current flow through the various line sections (AB, BC, CA) and the voltage at buses B and C. [8]



10. Compare rural and urban distribution network. [4]

11. Write short notes on: [4×3]

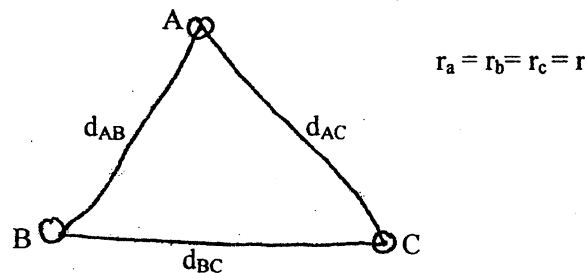
- a) HRC fuse
- b) Types of circuit breaker
- c) Basic protection scheme for transformer

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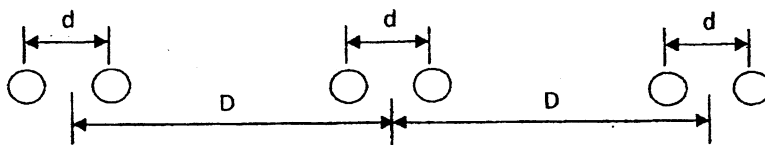
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- 1 a) The volume of a conductor material required in the power line decreases with the increase in voltage so also with the increase in power factor. Explain. [4]
- b) Write the reasons for adopting high transmission voltage in electrical power transmission. [4]
- c) An overhead line is erected across a span of 250m on the same level supports. The conductor has a diameter of 1.42cm and weighs 1.09Kg/m. The line is subjected to a wind pressure of 37.8 Kg/m² of the projected area. The radial thickness of ice is 1.25cm. The line is carried by insulator string 1.43m long. Calculate: (i) Maximum sag in the deflected direction (ii) Sag in the vertical direction and (iii) The height of the lowest cross-arm to give minimum ground clearance of 7.62m. Assume that ice weighs 915 Kg/m³ and permissible tension in the conductor is 1663 Kg. [8]
2. a) Starting from a suitable point, derive an expression for the calculation of capacitance/phase/km of the transposed line with following configuration. [8]



- b) A 3-phase, 460 kV, 50 Hz transposed transmission line with flat-horizontal configuration is shown in figure below. The diameter of each sub-conductor is 5 cm. Calculate capacitive reactance per phase per km of the line. Also calculate the charging current and charging VAR per km of the line. (Assume: $D = 8\text{m}$ and $d = 40\text{cm}$) [8]



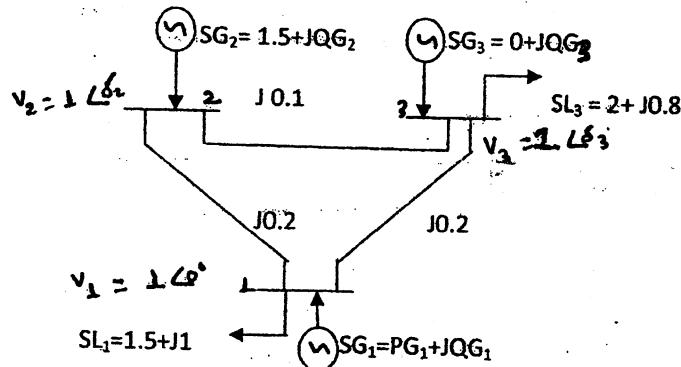
3. a. A 100 km long 3-phase transmission line has following line constants:

- resistance/km/phase = 0.1 ohm
- reactance/km/phase = $j0.5$ ohm
- susceptance /km/phase = $j10^{-5}$ S

If the line supplies a load of 20 MW, 0.9 pf lagging at 66 kV to the receiving end, calculate, by using nominal pi-method; (i) Sending end power factor, (ii) voltage regulation, and (iii) transmission efficiency. [8]

- b. For the interconnected system as shown, line resistance may be neglected and pu line reactances are as shown and the voltage at all buses should be 1 pu. The pu values of loads and active power generated at the different buses are also shown. Calculate reactive power generated at all buses.

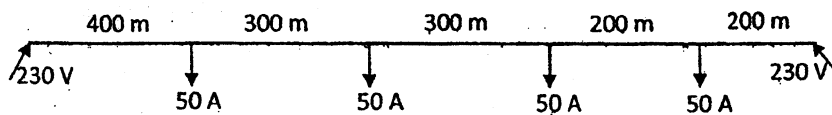
[8]



4. a) What do you mean by power system protection? Describe different type of circuit breakers with their relative merits, demerits and applications.
- b) A DC distributor fed at both ends at 230V with conductor loop resistance of 0.2 Ohm/km is loaded as shown in figure below. Determine the minimum voltage and along the distributor and the point of minimum voltage.

[2+6]

[8]



[4×4]

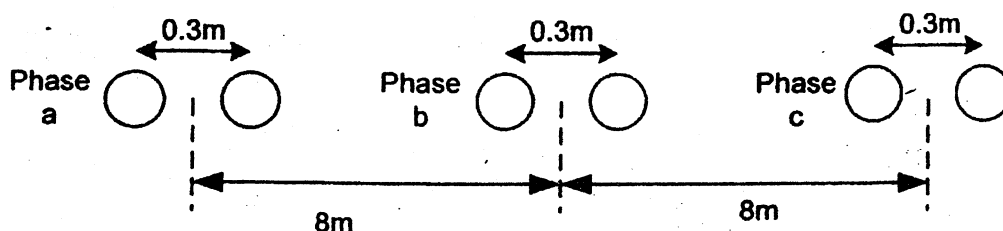
5. Write short notes on:
- Fault detection of underground cable
 - Types of relays
 - Rural vs. urban distribution
 - Scourge impedance loading of a transmission line

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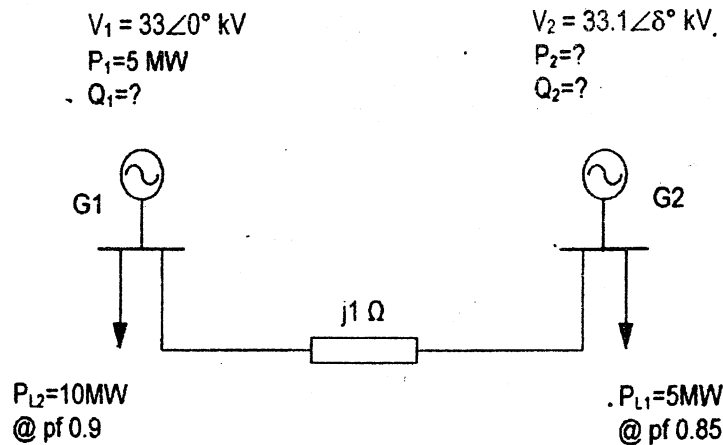
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1. a) What are the reasons for adopting high transmission voltage in electrical power transmission? Also explain the issues that limit selection of high working voltage. [8]
- b) Nepal Electricity Authority is planning to construct a 66kV transmission line, in which the tower span is 150m. The requirements are: ground clearance = 15m and maximum stress = 1250kg/m^2 . A consultant proposes a line conductor with cross-sectional area 1.25cm^2 and weight of 0.8kg/m , in which the designed sag was 3.45m. Comment on the design whether the resultant stress will be within the requirement, and also determine the height at which the conductors to be supported. [8]
2. a) Explain the effect of earthing in the capacitance of a transmission line. In which cases, between the overhead and underground cable, the earthing effect is more prominent. [8]
- b) A 400kV bundled conductor has the lines spacing as shown below. Assuming that each conductor in a phase carries 50% of total current and radius of each conductor being 2cm, calculate GMD and GMR of the configuration. If applicable, use these values to calculate the inductance and capacitance per phase of the configuration. What will be the net capacitive charging var per km for this configuration? The line is operated at 50hz. [8]

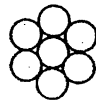


3. a) With the aid of power flow equations for a short transmission line with $R \ll X$, explain how the decoupled control of active power and reactive power can be achieved by regulating the power angle and voltage drop, respectively. [8]
- b) A 3-phase, 50Hz, 150km line has a resistance, inductive reactance and capacitive shunt admittance of 0.1 ohm, 0.5ohm and 3.1×10^{-6} S per km per phase. Construct the nominal π model for this line. If the line delivers 50MW at 110 kV and 0.8 p.f. lagging, determine the sending end voltage, sending end current and efficiency of the line. [8]

4. a) Mention the type of feeders in distribution system and explain, in detail, one of them. [8]
 b) For an interconnected system as shown, calculate reactive power injected by G1; and active power, reactive power and power angle of G2. Assume the pf given in the loads are lagging one. [8]



5. a) What is the implication of active and reactive power supply and demand mismatch in an electric power system? [8]
 b) Briefly describe the significance of line supports in power transmission system. [4]
 c) Compute the self GMD of the following conductor. Each strand has a radius of 4mm. [4]



6. Write short note on following (Attempt any four: (a) & (b) are compulsory.) [4×4]
 a) Generator protection scheme
 b) Circuit breaker
 c) Underground cable
 d) Computer application of power system
 e) Surge impedance loading
 f) Skin effect and proximity effect

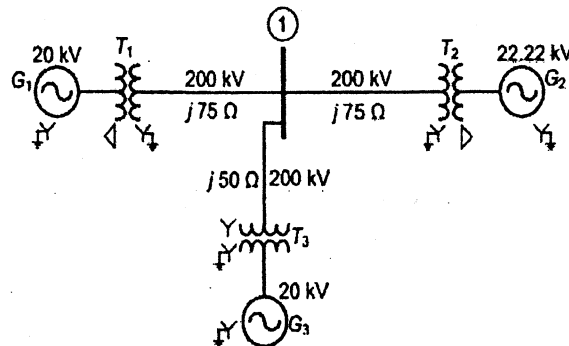
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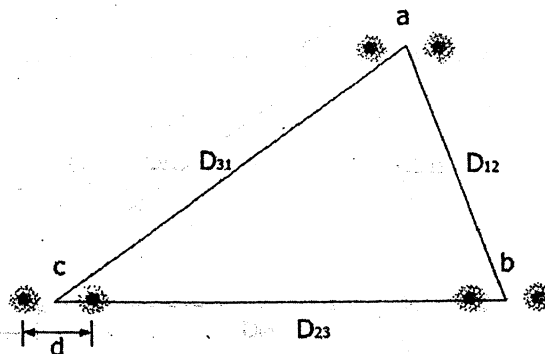
1. a) Single line diagram of an interconnected power system shown in figure below with data given in the following table. Assuming that the shunt parameters of the transformers are negligible, develop the reactance diagram. [8]

Generator G_1	200MVA, 20kV, $X_{G1} = j0.225\Omega$
Generator G_2	300MVA, 18kV, $X_{G2} = j0.225\Omega$
Generator G_3	300MVA, 20kV, $X_{G3} = j0.225\Omega$
Transformer T_1	200MVA, 220/20kV, $X_{T1} = j0.225\Omega$
Transformer T_2	300MVA, 220/20kV, $X_{T1} = j0.225\Omega$
Transformer T_3	300MVA, 220/22kV, $X_{T3} = j0.225\Omega$



- b) Compare the characteristics and applications of overhead conductor and underground cables. [8]
2. a) What are the parameters of transmission line? Explain how these parameters are affected by the size of the conductor and the configuration of the transmission line. [8]
- b) A 460kV bundled conductor has the lines spacing as shown below. Assuming that each conductor in a phase carries 50% of total phase current and the effective radius of each conductor being 2 cm, calculate GMD and GMR of the configuration. If applicable, use these values to calculate the inductance and capacitance per phase of the configuration. What will be the net capacitive charging var per km length for this configuration? A 3-phase, 50Hz, 345KV overhead transmission line has two sub-conductors per phase and line spacings as shown below. [8]

$$\begin{aligned}
 D_{12} &= 7\text{m} \\
 D_{23} &= 8\text{m} \\
 D_{31} &= 10\text{m} \\
 d &= 0.3\text{m}
 \end{aligned}$$



3. a) Derive an expression for the voltage regulation of short transmission line. With the help of derived results, point out the factors that affect the voltage regulation. Also suggest the measures for better voltage regulation. [8]

- b) A 3-phase, 50Hz overhead transmission line has the following constants: [8]

Resistance/phase = 9.6Ω

Inductance/phase = 0.097mH

Capacitance/phase = $0.765\mu\text{F}$

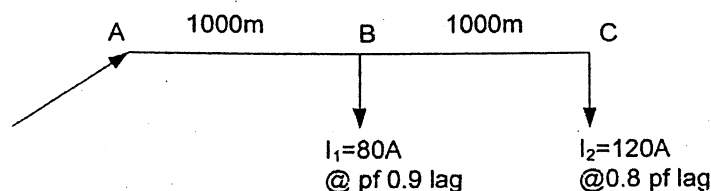
If the line is supplying a balanced load of 24000kVA 0.8 p.f. lagging at 66kV , calculate: (i) sending end current (ii) Line value of sending end voltage (iii) Sending end power factor (iv) Percentage regulation, and (v) Transmission efficiency.

4. a) What do you mean by an interconnected power system? Explain the merits of interconnected power system over isolated one. What are the steps to be undertaken before a generator is connected with a power grid? [8]

- b) For the single line diagram of the distributor with impedance of distributor/km = $(0.05 + j0.1)\Omega$ below. If the voltage at the far end C is maintained at 230V , calculate: [8]

i) Voltage at the sending end

ii) Power angle between voltages at the two ends A and C.



5. a) Draw a neat sketch of a cable used in underground application and describe the functions of each components. [5]

- b) Classify power cables based on insulation used. [3]

- c) A 1-phase overhead line has radius of phase conductor equal to 8mm and radius of neutral conductor equal to 6mm . Compute the inductance of the line if its length is 1.2km . [5]

- d) What is the effect of earth on capacitance of an overhead line? Explain briefly. [3]

6. Write short notes on: (any four) [4×4]

- Fuse as a protective device
- Generator protection schemes
- Series and shunt compensation
- Per unit system
- Skin effect and proximity effect

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INSTITUTE OF ENGINEERING
Examination Control Division
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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine (EE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) What are different types of losses in transformer? Derive the expression of efficiency of transformer. [8]
- b) An iron ring of mean diameter 100cm and cross sectional area 10cm² is wound with 1000 turns and has $\mu_r = 2000$. Compute (i) reluctance (ii) flux produced when the current through the coil is 1A (iii) Flux in the ring if a saw cut of 1mm length is made, the current through the coil remaining the same. [8]
2. a) A 25 KVA, single phase, 11 KV / 400V transformer has impedance of primary and secondary $0.4 + j2\Omega$ and $0.02 + j1\Omega$ respectively. Determine the load terminal voltage and primary current at half load. [8]
- b) Describe the construction and working principle of a dc generator with neat diagram. Also derive the emf equation of a dc generator. [8]
3. a) Describe different methods of controlling the speed of shunt DC motor. [8]
- b) Explain with necessary vector diagram how rotating magnetic field is produced in a three phase induction motor. Also explain how this rotating magnetic field helps the motor to rotate. [8]
4. a) Explain torque slip characteristics of 3-phase induction motor. Why the induction motor operates only in linear portion of torque-slip characteristics. [8]
- b) A 3.3 KV, 3-phase star connected synchronous motor has impedance of $0.2 + j2.2\Omega$ /phase of the armature winding. The motor is operated at 0.5 pf leading with line current of 100 A. Determine the back emf per phase and also draw phasor diagram. [8]
5. Give reasons for the following statements. [4x4]
 - a) Single phase induction motors are not self starting
 - b) Servo motor has longer length and smaller diameter compared to other normal motor
 - c) DC series motor can also be operated from ac supply
 - d) Hysteresis and eddy current losses depends on the frequency of supply system

$$H = \frac{B}{\mu_0 \mu_r}$$

$$\phi = BA$$

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine (EE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. a) Explain the operating principle of an ideal transformer and derive the emf equation.
 b) A ring of 30 cm mean diameter is made up of round iron rod 2.5 cm in diameter. A saw cut of 1 mm is made on the ring. It is uniformly wound with 500 turns of wire. Calculate the current required by the exciting coil to produce a total flux of 4m Wb. Assume a relative permeability of iron at this flux density as 800.
2. a) Explain the operation principle of dc generator. What are main functions of carbon brush in dc generator?
 b) A 20 kVA, 250V/2500V, 50Hz single phase transformer gave the following test results:
 No-load test (on L.V. side): 250V, 1.4A, 105 watts
 Short circuit test (on H.V. side): 120V, 8 A, 320 watts
 Calculate the equivalent circuit parameters referred to primary side and draw the equivalent circuit.
3. a) Sketch and explain the torque slip characteristics of a 3-phase induction motor indicating the starting torque, maximum torque and the operating region. How does rotor resistance affect the torque slip characteristics?
 b) A 200V DC shunt motor drives a centrifugal pump where constant torque is required. The motor draws a current of 50 A when running at 1000rpm. What value of resistance must be inserted in the armature circuit to reduce the speed to 800rpm at constant torque? Given that armature winding resistance, $R_a = 0.1 \Omega$ and field winding resistance, $R_f = 100 \Omega$
4. a) With the help of phasor diagrams, explain the effect of excitation in a 3-phase synchronous motor.
 b) A 4-pole, 50 Hz, 3 phase induction motor develops a starting torque of 50 N-m. The rotor winding has an impedance of $(0.8+j2) \Omega$ per phase at stand still. At what speed the motor will develop maximum torque and calculate magnitude of the maximum torque.
5. a) What do you understand by double field revolving theory? Explain it with the help of a neat diagram.
 b) A 500 KVA, 50 Hz, 6600V/400V, 1- phase transformer have primary and secondary winding resistances are 0.4Ω and 0.001Ω respectively. If the iron loss is 3.0 KW, Calculate the efficiency at (a) full load (b) half full load.

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine (EE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) What are different types of losses in transformer? Derive the expression of efficiency of transformer. [8]
- b) An iron ring of mean diameter 100cm and cross sectional area 10cm^2 is wound with 1000 turns and has $\mu_r = 2000$. Compute (i) reluctance (ii) flux produced when the current through the coil is 1A (iii) Flux in the ring if a saw cut of 1mm length is made, the current through the coil remaining the same. [8]
2. a) A 25 KVA, single phase, 11 KV / 400V transformer has impedance of primary and secondary $0.4 + j2\Omega$ and $0.02 + j1\Omega$ respectively. Determine the load terminal voltage and primary current at half load. [8]
- b) Describe the construction and working principle of a dc generator with neat diagram. Also derive the emf equation of a dc generator. [8]
3. a) Describe different methods of controlling the speed of shunt DC motor. [8]
- b) Explain with necessary vector diagram how rotating magnetic field is produced in a three phase induction motor. Also explain how this rotating magnetic field helps the motor to rotate. [8]
4. a) Explain torque slip characteristics of 3-phase induction motor. Why the induction motor operates only in linear portion of torque-slip characteristics. [8]
- b) A 3.3 KV, 3-phase star connected synchronous motor has impedance of $0.2 + j2.2\Omega/\text{phase}$ of the armature winding. The motor is operated at 0.5 pf leading with line current of 100 A. Determine the back emf per phase and also draw phasor diagram. [8]
5. Give reasons for the following statements. [4×4]
 - a) Single phase induction motors are not self starting
 - b) Servo motor has longer length and smaller diameter compared to other normal motor
 - c) DC series motor can also be operated from ac supply
 - d) Hysteresis and eddy current losses depends on the frequency of supply system

Exam.	OLD Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine I (EG577EE)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

- 1a) Why soft magnetic material is used to make transformer core or armature core of the electrical equipment? State and explain Faraday's laws of electromagnetic induction. Describe different processes of EMF induced in a coil. [10]
- b) A 30 cm long circular iron is bent into circular ring and 600 turns of windings are wound on it. The diameter of the rod is 20mm and relative permeability of the iron is 4000. A time varying current $I = 5 \sin 314t$ is passed through the winding. Calculate inductance and average value of the emf induced in the coil. [6]
- 2a) A 25 kVA, 250V/2500V, 50 Hz single phase transformer gave the following test results:
 No load test (on L. V. side): 250V, 1.4A, 105 watts
 Short circuit test (on H. V. side): 120V, 8A, 320 watts
 Calculate the equivalent circuit parameters referred to primary side and draw the equivalent circuit. [8]
- b) Explain the operation of transformer at different loading conditions (resistive, inductive, capacitive) showing their corresponding circuit diagram and phasor diagram. [8]
- 3.a) What is meant by transformer inrush current? Discuss the term "doubling effect" in transformer in detail. [2+6]
- b) A 4-Pole dc shunt generator has wave wound armature. The armature and field winding resistances are 0.2Ω and 60Ω respectively. The brush contact drop is 1 volt per brush. The generator is delivering a power of 3 kW at 120V.
 Calculate:
 a) Total armature current coming out from the brush.
 b) Current in each armature conductor.
 c) Generator EMF (E). [2+3+3]
- 4 a) Discuss the types of armature winding in dc machine in brief. Draw the sketch for lap winding in which no. of slot = 12, no. of pole = 2 and no. of commutator segments = 12. [4+4]
- b) A 240V dc shunt motor has armature winding resistance of 0.4Ω and field winding resistance of 120Ω . It draws a current of 27A at half load and the corresponding speed is 600rpm.
 i) If a resistance of 1Ω connected in series with the armature winding keeping the load torque constant to half load torque, calculate the new speed.
 ii) If a resistance of 1Ω connected in series with the armature winding and the load torque is increased to full load torque, calculate the new speed. [4+4]
- 5 a) What are the types of dc generator, discuss each type in brief. Explain loading characteristics of compound dc generator. [4+4]
- b) Explain two reaction model of salient pole synchronous machine. [8]
- 6 a) How does voltage build up occurs in an induction generator? Explain [8]
- b) A 4-pole, 50Hz, 3 phase induction motor with star connected rotor gives 500V between the slip rings at standstill. Calculate the magnitude and frequency of emf induced per phase in rotor circuit at a speed of 1460RPM. [8]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine (EE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) A rectangular iron core is shown in figure 1. It has a mean length of magnetic path of 100 cm, cross-section of (2 cm × 2 cm), relative permeability of 1400 and an air-gap of 5 mm cut in the core. The three coils carried by the core have number of turns, $N_a = 335$, $N_b = 600$ and $N_c = 600$; and the respective currents are 1.6 A, 4 A and 3 A. The directions of the currents are as shown in the figure. Find the flux in the air-gap. [6]

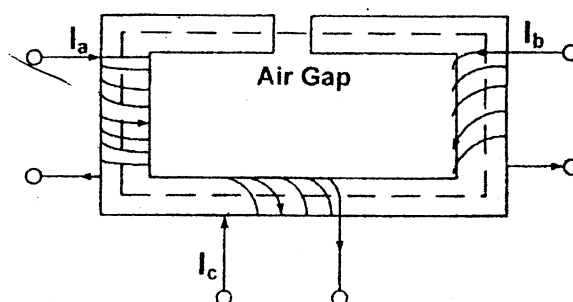


Figure 1

- b) State Faraday's Laws of electromagnetic induction. Distinguish between statically induced emf and dynamically induced emf. [6]
2. a) Explain the working of an ideal transformer under (i) no-load and (ii) loaded conditions and derive expressions for voltage and current ratios relating to transformer turns ratio. [4+4]
- b) The following test results were obtained for open circuit and short circuit tests on a 8 kVA, 400/120 V, 50 Hz transformer: [8]
- Open-circuit Test (LV Side) : 120 V, 4 A, 75 W
Short-circuit Test (HV Side) : 9.5 V, 20 A, 110 W
- Calculate the equivalent circuit parameters referred to high voltage side. Also calculate the efficiency at half full load and 0.8 power factor lagging load.
3. a) Explain the working principle of dc generator with neat diagram. [3+3]
- b) A short shunt compound generator supplies a load current of 100 A at 250 V. The generator has the following winding resistances: shunt field 130 Ω , armature 0.1 Ω and the series field 0.1 Ω . Find the emf generated and the armature current, if the brush drop is 1 V per brush. [6]

4. a) What is back emf? How does back emf play an important role in DC motor? [2+4]
b) A dc shunt motor runs at 600 RPM taking 60 A from a 230 V supply. Armature resistance is 0.2Ω and field resistance is 115Ω . Find the speed when the current through the armature is 30 A. [6]
5. a) Explain the torque-slip characteristics of an induction motor. Show the condition for which the maximum torque develops in the induction motor. [3+3]
b) A 3-phase delta connected 440 volts, 50 Hz, 4-pole induction motor has a rotor stand-still emf per phase of 130 volts. If the motor is running at 1,440 RPM, calculate for this speed : (i) the slip, (ii) the frequency of rotor induced emf, (iii) the value of the rotor induced emf per phase, and (iv) stator to rotor turn ratio. [4]
6. a) What do you mean by V-curve and inverted V-curve for a synchronous motor? Explain with a neat diagram. [6]
b) What are the advantages of rotating magnetic system and stationary armature system in ac machine? [4]
c) Write short notes on the following: [2×4]
i) Universal motor
ii) AC servo motor

Exam.	OLD Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine I (EG577EE)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1a) Why soft magnetic material is used to make transformer core or armature core of the electrical equipment? State and explain Faraday's laws of electromagnetic induction. Describe different processes of EMF induced in a coil. [10]

b) A 30 cm long circular iron is bent into circular ring and 600 turns of windings are wound on it. The diameter of the rod is 20mm and relative permeability of the iron is 4000. A time varying current $I = 5 \sin 314t$ is passed through the winding. Calculate inductance and average value of the emf induced in the coil. [6]

2a) A 25 kVA, 250V/2500V, 50 Hz single phase transformer gave the following test results:

No load test (on L. V. side): 250V, 1.4A, 105 watts

Short circuit test (on H. V. side): 120V, 8A, 320 watts

Calculate the equivalent circuit parameters referred to primary side and draw the equivalent circuit. [8]

b) Explain the operation of transformer at different loading conditions (resistive, inductive, capacitive) showing their corresponding circuit diagram and phasor diagram. [8]

3.a) What is meant by transformer inrush current? Discuss the term "doubling effect" in transformer in detail. [2+6]

b) A 4-Pole dc shunt generator has wave wound armature. The armature and field winding resistances are 0.2Ω and 60Ω respectively. The brush contact drop is 1 volt per brush. The generator is delivering a power of 3 kW at 120V.

Calculate:

a) Total armature current coming out from the brush.

b) Current in each armature conductor.

c) Generator EMF (E). [2+3+3]

4 a) Discuss the types of armature winding in dc machine in brief. Draw the sketch for lap winding in which no. of slot = 12, no. of pole = 2 and no. of commutator segments = 12. [4+4]

b) A 240V dc shunt motor has armature winding resistance of 0.4Ω and field winding resistance of 120Ω . It draws a current of 27A at half load and the corresponding speed is 600rpm.

i) If a resistance of 1Ω connected in series with the armature winding keeping the load torque constant to half load torque, calculate the new speed.

ii) If a resistance of 1Ω connected in series with the armature winding and the load torque is increased to full load torque, calculate the new speed. [4+4]

5 a) What are the types of dc generator, discuss each type in brief. Explain loading characteristics of compound dc generator. [4+4]

b) Explain two reaction model of salient pole synchronous machine. [8]

6 a) How does voltage build up occurs in an induction generator? Explain [8]

b) A 4-pole, 50Hz, 3 phase induction motor with star connected rotor gives 500V between the slip rings at standstill. Calculate the magnitude and frequency of emf induced per phase in rotor circuit at a speed of 1460RPM. [8]

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Examination Control Division

2071 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine (EE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) A rectangular iron core is shown in figure 1. It has a mean length of magnetic path of 100 cm, cross-section of (2 cm × 2 cm), relative permeability of 1400 and an air-gap of 5 mm cut in the core. The three coils carried by the core have number of turns, $N_a = 335$, $N_b = 600$ and $N_c = 600$; and the respective currents are 1.6 A, 4 A and 3 A. The directions of the currents are as shown in the figure. Find the flux in the air-gap. [6]

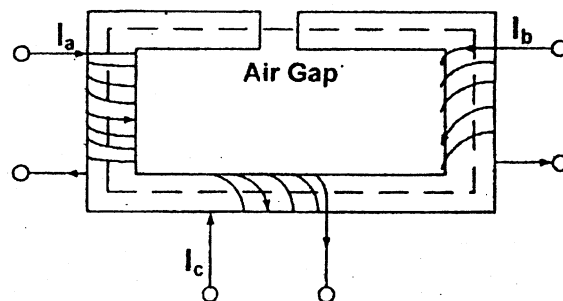


Figure 1

- b) State Faraday's Laws of electromagnetic induction. Distinguish between statically induced emf and dynamically induced emf. [6]
2. a) Explain the working of an ideal transformer under (i) no-load and (ii) loaded conditions and derive expressions for voltage and current ratios relating to transformer turns ratio. [4+4]
- b) The following test results were obtained for open circuit and short circuit tests on a 8 kVA, 400/120 V, 50 Hz transformer: [8]
- Open-circuit Test (LV Side) : 120 V, 4 A, 75 W
Short-circuit Test (HV Side) : 9.5 V, 20 A, 110 W
- Calculate the equivalent circuit parameters referred to high voltage side. Also calculate the efficiency at half full load and 0.8 power factor lagging load.
3. a) Explain the working principle of dc generator with neat diagram. [3+3]
- b) A short shunt compound generator supplies a load current of 100 A at 250 V. The generator has the following winding resistances: shunt field 130 Ω , armature 0.1 Ω and the series field 0.1 Ω . Find the emf generated and the armature current, if the brush drop is 1 V per brush. [6]

4. a) What is back emf? How does back emf play an important role in DC motor? [2+4]
- b) A dc shunt motor runs at 600 RPM taking 60 A from a 230 V supply. Armature resistance is 0.2Ω and field resistance is 115Ω . Find the speed when the current through the armature is 30 A. [6]
5. a) Explain the torque-slip characteristics of an induction motor. Show the condition for which the maximum torque develops in the induction motor. [3+3]
- b) A 3-phase delta connected 440 volts, 50 Hz, 4-pole induction motor has a rotor stand-still emf per phase of 130 volts. If the motor is running at 1,440 RPM, calculate for this speed : (i) the slip, (ii) the frequency of rotor induced emf, (iii) the value of the rotor induced emf per phase, and (iv) stator to rotor turn ratio. [4]
6. a) What do you mean by V-curve and inverted V-curve for a synchronous motor? Explain with a neat diagram. [6]
- b) What are the advantages of rotating magnetic system and stationary armature system in ac machine? [4]
- c) Write short notes on the following: [2×4]
- i) Universal motor
- ii) AC servo motor

Examination Control Division
2071 Magh

Exam.	OLD Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine I (EG577EE)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- 1a) Why soft magnetic material is used to make transformer core or armature core of the electrical equipment? State and explain Faraday's laws of electromagnetic induction. Describe different processes of EMF induced in a coil. [10]
- b) A 30 cm long circular iron is bent into circular ring and 600 turns of windings are wound on it. The diameter of the rod is 20mm and relative permeability of the iron is 4000. A time varying current $I = 5 \sin 314t$ is passed through the winding. Calculate inductance and average value of the emf induced in the coil. [6]
- 2a) A 25 kVA, 250V/2500V, 50 Hz single phase transformer gave the following test results:
No load test (on L. V. side): 250V, 1.4A, 105 watts
Short circuit test (on H. V. side): 120V, 8A, 320 watts
Calculate the equivalent circuit parameters referred to primary side and draw the equivalent circuit. [8]
- b) Explain the operation of transformer at different loading conditions (resistive, inductive, capacitive) showing their corresponding circuit diagram and phasor diagram. [8]
- 3.a) What is meant by transformer inrush current? Discuss the term "doubling effect" in transformer in detail. [2+6]
- b) A 4-Pole dc shunt generator has wave wound armature. The armature and field winding resistances are 0.2Ω and 60Ω respectively. The brush contact drop is 1 volt per brush. The generator is delivering a power of 3 kW at 120V.
Calculate:
a) Total armature current coming out from the brush.
b) Current in each armature conductor.
c) Generator EMF (E). [2+3+3]
- 4 a) Discuss the types of armature winding in dc machine in brief. Draw the sketch for lap winding in which no. of slot = 12, no. of pole = 2 and no. of commutator segments = 12. [4+4]
- b) A 240V dc shunt motor has armature winding resistance of 0.4Ω and field winding resistance of 120Ω . It draws a current of 27A at half load and the corresponding speed is 600rpm.
i) If a resistance of 1Ω connected in series with the armature winding keeping the load torque constant to half load torque, calculate the new speed.
ii) If a resistance of 1Ω connected in series with the armature winding and the load torque is increased to full load torque, calculate the new speed. [4+4]
- 5 a) What are the types of dc generator, discuss each type in brief. Explain loading characteristics of compound dc generator. [4+4]
- b) Explain two reaction model of salient pole synchronous machine. [8]
- 6 a) How does voltage build up occurs in an induction generator? Explain [8]
- b) A 4-pole, 50Hz, 3 phase induction motor with star connected rotor gives 500V between the slip rings at standstill. Calculate the magnitude and frequency of emf induced per phase in rotor circuit at a speed of 1460RPM. [8]

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INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine (EE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) The flux in transformer remains practically constant from no load to full load. Justify the statement. [4]
- b) Derive an expression for Cu saving in an auto-transformer. [4]
- c) A 230 V / 2300 V single-phase transformer is excited by 230 V ac voltage. The equivalent resistance and reactance referred to primary side are 0.1Ω and 0.4Ω respectively. Given that $R_0 = 500 \Omega$ and $X_0 = 200 \Omega$. The load impedance is $(400 + j600) \Omega$. Calculate: (i) Primary current and input power factor (ii) Secondary terminal voltage. [8]
2. a) Derive an emf equation for a dc generator. [4]
- b) DC shunt generator shall be started keeping its output terminal open. Justify the statement. [4]
- c) A 4 pole, 250 V long shunt dc compound generator supplies a load of 10 KW at the rated voltage. The armature, series and shunt field resistances are 0.1Ω , 0.15Ω and 250Ω respectively. The armature is lap wound with 300 conductors. If the flux per pole is 50 mWb, calculate the speed of the generator. [8]
3. a) With the help of a neat sketch, explain the working principle of three terminal DC motor starter. [5]
- b) A dc series motor of resistance 1Ω between terminals runs at 1,000 RPM at 250 V with a current of 20 A. Find the speed at which it will run when connected in series with a 6Ω resistance and taking the same current at the same supply voltage. [5]
- c) A circular iron core has a cross-sectional area of 5 sq.cm. and mean length of 25 cm including an air gap of 4 mm. The core is wound with 500 turns of winding. Calculate the inductance of the coil. If a dc current of 10 Ampere passed through the coil, calculate magnetic flux in the core. Given that relative permeability of the core is 2000. [6]
4. a) What will be the condition for maximum torque and explain torque slip characteristics of 3-phase induction motor. [8]
- b) A 3-phase, 50 Hz induction motor has starting torque which is 1.25 times full load torque and a maximum torque which is 2.5 times the full load torque. Neglecting stator resistance and rotational losses and assuming constant rotor resistance. Find [8]
 - i) slip at maximum torque
 - ii) the slip at full load
 - iii) the current at starting in per unit full load current
5. a) With the help of phasor diagrams, explain the effect of excitation in a 3-phase synchronous motor. [8]
- b) A 1200 KVA, 6600 V, 3-phase star connected stator of a synchronous generator has a armature resistance of $0.4 \Omega/\text{phase}$ and synchronous reactance of $6 \Omega/\text{phase}$. The generator delivers full load current at pf of 0.8 lagging at normal rated voltage. Calculate the terminal voltage for the same excitation and load current at 0.8 pf leading. [8]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine (EE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Explain the working of an ideal transformer under (i) no-load and (ii) loaded conditions and derive expressions for voltage and current ratios relating to transformer ratio. [8]
b) The following test results were obtained on a 20 kVA, 2200/220 V, 50 Hz single phase transformer: [8]
Open-circuit Test (LV Side): 220 V, 1.1 A, 125 W
Short-circuit Test (HV Side): 52.7 V, 8.4 A, 287 W
Calculate the equivalent circuit referred to L.V side and draw the equivalent circuit.
2. a) Explain torque-armature current and speed-torque characteristics of DC shunt and DC series motor. [8]
b) A 220V dc shunt motor draws a current of 40A at full load and runs with speed of 1400rpm. Calculate the value of resistance required to be inserted in the armature circuit so that speed drops to 1200rpm at constant load. Given that $R_a = 0.02 \Omega$ and $R_f = 100 \Omega$. [8]
3. a) Explain why synchronous motor is not self starting? Explain the starting method using damper winding. [8]
b) A 4-pole dc shunt generator has wave wound armature. The armature and field winding resistance are 0.2 Ω and 60 Ω respectively. The brush contact drop is 1V per brush. The generator is delivering a power of 3 kW at 120V. Calculate: [8]
i) Total armature current coming out from the brush
ii) Current in each armature conductor
iii) Generated EMF (E)
4. a) Explain the torque-slip characteristics of 3 phase induction motor. Show the condition for which the maximum torque develops in the induction motor. Discuss the effect of variation of rotor resistance on this maximum torque. [8]
b) A 8-pole, 50 Hz, 3 phase induction motor develops a starting torque of 50 N-m. The rotor winding has an impedance of $(0.8 + j2) \Omega$ per phase. At what speed the motor will develop maximum torque and calculate the magnitude of maximum torque. [8]
5. a) What do you understand by double field revolving theory? Explain it with the help of a neat diagram. [8]
b) A ring of 30 cm mean diameter is made up of round iron rod 2.5 cm in diameter. At one end, a saw cut of 1 mm wide is made through it. It is uniformly wound with 500 turns of wire. Calculate the current required by the exciting coil to produce a total flux of 4 mWb. Take relative permeability of iron as 800. Neglect leakage and fringing. [8]

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine (EE554)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
 - ✓ Attempt All questions.
 - ✓ All questions carry equal marks.
 - ✓ Assume suitable data if necessary.
1. a) Explain the no-load and loaded operation of an Ideal transformer. Prove that the net magnetic flux in the core remains constant at any load.
b) A magnetic circuit consists of a circular iron core having mean length of 10cm and cross-sectional area of 100mm^2 . The air gap is 2mm and the core has 600 turns of winding. Calculate the magnitude of current to be passed through the winding to produce air gap flux of 1 Telsa. Given $\mu_r = 4000$.
 2. a) Explain the working principle of a d.c. motor and derive the equation of Torque developed by the armature of the d.c. motor.
b) A dc series motor with armature resistance of 0.06Ω , and field winding resistance of 0.04Ω is supplied by a 220V source. If the motor draws 25A when running at 1200rpm, calculate the current drawn by motor when running at 800 rpm.
 3. a) Explain the Armature control method and field control method of speed control of DC shunt motor.
b) A 4 pole dc shunt generator has armature and field winding resistance are of 0.2Ω and 60Ω respectively. The brush contact drop is 1V per brush. The generator is delivering a power of 3KW at 120V. Calculate:
 - i) Total armature current coming out from the brush
 - ii) Current in each armature conductor
 - iii) Generated EMF(E)
 4. a) Explain the armature reaction in a synchronous generator for resistive, inductive and capacitive loading with necessary diagram.
b) A-3phase, slip-ring, induction motor with star-connected rotor has an induced e.m.f. of 120 volts between slip-rings at standstill with normal voltage applied to the stator. The rotor winding has resistance per phase of 0.3 Ohm and standstill leakage reactance per phase of 1.5 Ohm. Calculate the current/phase when running short-circuited with 4% slip.
 5. a) Explain the nature magnetic field created by signal phase induction motor with the help of double field revolving theory and explain why single phase induction motor is self starting.
b) Write about the working principle of a signal stack stepper motor with neat diagram.

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Explain the working principle of a single phase induction motor. What is the effect of air gap in the magnetic circuit? [5+3]

- b) A cast steel ring has a circular cross section of 3cm in diameter and mean circumference of 80cm. A 1mm air-gap is cut in the ring which is wound with a coil of 600 turns. Estimate the current required to establish a flux of 0.75 mWb in the air-gap. [8]

Magnetization data:

H (AT/m)	200	400	600	800	1000	1200	1400	1600
B(T)	0.1	0.32	0.6	0.9	1.08	1.18	1.27	1.32

2. a) Explain the transformer on load and no load with the phasor diagram of resistive and capacitive load. [8]

- b) Test data on a 1- ϕ , 250/500V, 50Hz transformer are: [8]

O.C. Test: 250V, 1A, 80W (carried on L.V. Side)

S.C. Test: 20V, 12A, 100W (carried on H.V. side)

Then draw the equivalent circuit referred to primary side and find out the output power to obtain maximum efficiency at 0.9 lag p.f.

3. a) A 500-KVA, 3- ϕ , 50Hz transformer has a voltage ratio (line voltage) of 33/11KV and is delta/star connected. The resistances per phase are: High voltage 35 Ω , low voltage 0.876 Ω and the iron loss is 3050W. Calculate the value of efficiency at full-load and one-half of full-load respectively at 0.8 p.f. [8]

- b) Why the dc motor draws large current at starting? Justify it clearly and also describe the working of 3-point dc motor starter. [3+5]

4. a) A short shunt compound generator delivers a current of 80A to the load at 220V. The shunt field, series and armature winding resistances are 100 Ω , 0.05 Ω and 0.1 Ω respectively. Calculate the emf generated by the armature. [8]

- b) Draw and explain torque-slip characteristics of 3- ϕ induction motor, showing clearly the starting torque, maximum torque and normal operating region. [8]

5. a) A 208V, 60 Hz, 4 pole, 3- ϕ induction motor has a full-speed of 1755 rpm. [8]
Calculate: (i) asynchronous speed, (ii) the slip and (iii) rotor frequency.

- b) Write down the criteria for synchronizing two 3- ϕ alternators with the detail explanation. [8]

6. Write short notes on: [4 \times 3]

- a) Capacitor starting of 1- ϕ induction motor
- b) Armature reaction in dc machine
- c) Eddy current loss
- d) Starting methods of synchronous motor

Examination Control Division

2068 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT, BME, BIE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. State whether the following statements are true or false and justify them. [(1+3)×4]
 - a) Secondary of CT should not be kept open while the primary winding is energized.
 - b) DC series motor should always be started at no load.
 - c) Rotor core loss is often neglected in 3 phase induction motor.
 - d) Construction of auxiliary winding of 1 phase induction motor is different from that of the main winding.
2. a) Describe different types of losses on the transformer. Also derive the expression for the maximum efficiency of the transformer. [8]
 - b) A 10 kVA, 200/400V, 50HZ, 1 phase, transformer gave the following test results: [8]

OC test (HV open):	200V	1.3A	120W
SC test (LV short):	22V	30A	200W

Determine shunt and series branch parameters referred to Low Voltage Side and hence draw equivalent circuit diagram also.
3. a) Explain working principle of DC generator in detail and hence derive the expression of emf equation also. [8]
 - b) A 200V, dc shunt motor drives a centrifugal pump where torque is proportional to the square of speed. The motor draw a current of 50A when running at 1000 rpm. What value of resistance must be inserted in the armature circuit to reduce the speed to 800 rpm. Given: Armature resistance (R_a) = 0.1Ω and field winding resistance (R_f) = 100Ω . [8]
4. a) What do you mean by excitation control in synchronous motor? How synchronous motor can be operated in leading and lagging pf mode? [8]
 - b) A 8-pole, 50Hz, 3-ph induction motor develops a starting torque of 50N-m. The rotor winding has an impedance of $(0.8 + j4)\Omega$ per phase. At what speed the motor will develop maximum torque and calculate the magnitude of maximum torque. [8]
5. a) Why single phase induction motor are not self starting? Explain any two starting methods for single phase induction motor. [8]

- b) For the magnetic circuit shown below, calculate the value of current 'I' required to produce a magnetic flux density of 1.2 Tesla. [8]

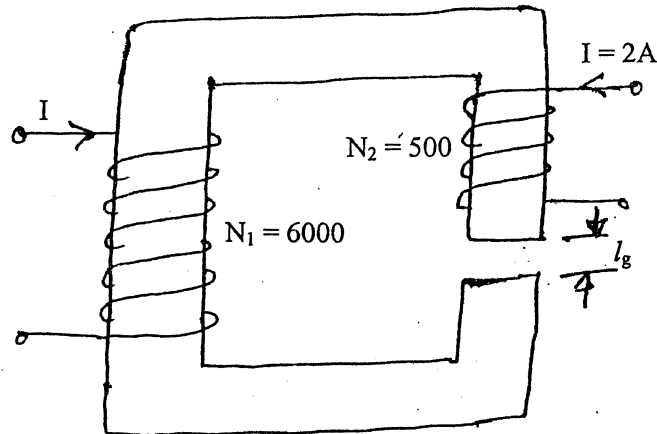
Given:

X – sectional area of core = 16 sq.cm

Air gap length (l_g) = 0.06cm

Mean length of core (l_c) = 40cm

Relative permeability (μ_r) = 6000



6. a) Explain the operating principle of stepper motor and servo motor. [8]
b) Describe the Torque-slip characteristics of a three phase induction motor. Also explain the effect of rotor resistance on T-S characteristics. [8]

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. Justify the following statements: [4×4]
 - a) DC series motor should never be started on no-load.
 - b) It is not possible to operate star delta transformer in parallel with star-star or delta-delta transformer.
 - c) Induction motor cannot develop torque when rotor runs at synchronous speed.
 - d) Salient pole alternators are suitable for low speed whereas cylindrical pole alternators for high speed.
2. a) What is meant by an instrument transformer? How they differ in principle of operation from that of power transformer? Explain with suitable diagram and mathematical expressions. [8]
 - b) Two 1- phase transformers with equal number of turns have impedance of $(0.5 + j3)\Omega$ and $(0.6 + j10)\Omega$ with respect to the secondary. If they operate in parallel, determine how they will share total load of 100 kW at pf 0.8 lagging. [8]
3. a) Explain with reason, the suitability of DC series, DC shunt and DC compound motors. Identify suitable DC motor for the following application: [8]
 - i) Electric traction ii) Vacuum cleaner
 - iii) Paper making iv) Shearing and punching
 - b) A long shunt compound generator has a shunt field winding of 1000 turns per pole, series field winding of 4 turns per pole and resistance of 0.05Ω . In order to obtain the rated voltage both at no load and full load for operation as shunt generator, it is necessary to increase field current by 0.2A. The full load armature current of compound generator is 80A. Calculate the diverter resistance connected in parallel of series field to obtain flat compound operation. [8]
4. a) What are hysteresis and eddy current losses? What are their significance in the operation of electric machine? Write down different methods to reduce them. [8]
 - b) An iron ring of mean diameter 15cm and 10 sq-cm cross sectional area is wound with 200 turns of wire. There is an air gap of 2mm cut in the ring. For a flux density of 1 Wb/m^2 and relative permeability of 500, find the exciting current, the inductance and stored energy. [8]
5. a) How does an induction motor adjust its current with the changes in shaft load? Explain the effect of type of connection of stator winding of slip ring induction motor. [8]

- b) A 3-ph induction motor has a ratio of maximum torque to full load torque as 2.5:1. Determine the ratio of actual starting torque to full load torque for star delta starting. Also calculate full load slip. [Given: rotor resistance per phase = 0.4Ω and rotor reactance per phase at stand still = 4Ω] [8]
6. a) Explain two reaction theory of salient pole synchronous machines. Describe a method of determining direct and quadrature axis synchronous reactance of 3 phase synchronous machine. [8]
- b) A 6.6 kV star connected, 3 phase synchronous motor works at constant voltage and constant excitation. It's synchronous reactance is $20\Omega/\text{phase}$, when the input is 100Kw and power factor is 0.8 leading. Find the power factor when the input is increased to 1500kW. [8]

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machines I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Identify various types of losses in a transformer. Derive the condition for maximum efficiency of the transformer. [8]

b) A circular iron core with mean length of 100cm and cross-sectional area of 50mm^2 has 500 turns winding on the core. Calculate the flux density in the core if 10A current flows in the coil. Take $\mu_r = 2000$ for the iron core and neglect saturation. [8]
2. a) Describe the open circuit test and short circuit test for a single phase transformer. [8]

b) A 4.2KV/120V, 50 Hz, 1-phase transformer has following series parameters: $R_1 = 1.4\Omega$, $X_1 = 3.5\Omega$, $R_2 = 0.04\Omega$, $X_2 = 0.1\Omega$. If the transformer draws 500A current on the secondary at rated terminal voltage, calculate voltage regulation at unity power factor. [8]
3. a) Explain the operating principle of a dc generator. Derive the expression of induced emf across generator terminals. [8]

b) A dc series motor with armature resistance of 0.06Ω , and field winding resistance of 0.04Ω is supplied by a 220V source. If the motor draws 25A when running at 1200 rpm, calculate the current drawn by motor when running at 800 rpm. [8]
4. a) Justify why the dc motor draws large current at starting. Describe the working of a 3-point dc motor starter. [8]

b) A 500 KVA, 50 Hz, 11KV/400V, 3-ph transformer has delta/star connection. Calculate the current drawn by the transformer from primary side when it delivers full load at rated terminal voltage at 0.8 lagging p.f. Assume ideal transformer operation. [8]
5. a) Describe the torque speed characteristics of an induction motor. Discuss the effect of rotor resistance and applied voltage on T-N characteristics of such motors. [8]

b) A 3-phase, 440V, 50Hz, 6-pole induction motor draws 50KW at 0.85 lagging p.f. from the source when connected to rated supply. If rotor rotates at 950 rpm, calculate (i) rotor loss and (ii) overall efficiency of the motor. The friction loss and stator loss are 2 KW and 1.5 KW respectively at this running condition. [8]
6. a) Derive the expression for electrical power of salient pole synchronous machine. Show the power angle characteristics for such machines. [8]

b) A 3-phase star connected, 5 MVA, 11 KV synchronous generator has armature resistance of 0.12Ω and synchronous reactance of 2Ω per phase. Calculate voltage regulation if the generator delivers full load at rated terminal voltage at 0.9 lagging p.f. Also find out generator power factor at which the voltage regulation is zero. [8]

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Electrical Machine I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

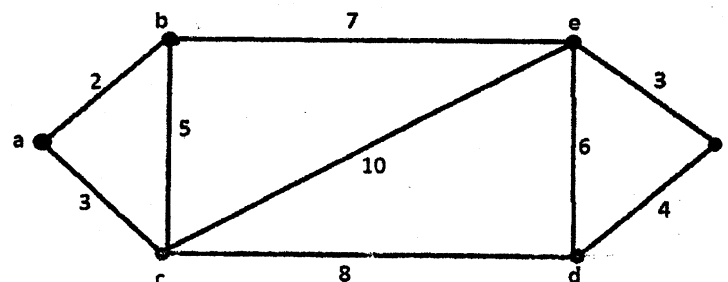
1. a) Explain the magnetic hysteresis and show that energy spent per cycle per unit volume equal to the area of hysteresis loop? [4+4]
 b) The core of an electromagnet is made of an iron rod 1cm diameter, bent into a circle of mean diameter 10cm, a radial air gap of 1mm being left between the ends of the rod. Calculate the direct current needed in coil of 2000 turns uniformly spaced around the core to produce a magnetic flux of 0.2m wb in the air gap. Assume that the relative permeability of the iron is 150. [8]
2. a) Explain how the efficiency of a transformer varies with load and derive the condition for maximum efficiency. [4+4]
 b) A 1 phase 250/500 V, 50 Hz transformer gave the following test results
 Open circuit test : 250V, 1A, 80W on H.V. Side
 Short-circuit test : 20V, 12A, 100W on L.V. Side
 Calculate the equivalent circuit parameter and draw the equivalent circuit referred to low voltage side and high voltage side.
3. a) Explain the phenomenon of "building up" of voltage in a dc shunt generator and there by state the conditions to be fulfilled for self excitation Also explain the terms critical resistance and critical speed? [8]
 b) A dc shunt generator gives full load output of 30 KW at a terminal voltage of 200V. The armature and shunt field resistances are 0.05Ω and 50Ω respectively. The iron and friction losses are 100W. Calculate (i) generated emf (ii) copper losses (iii) efficiency. [8]
4. a) Explain why the dc series motor can not be started without some mechanical load? Also discuss the armature control and field control method for speed control of dc shunt motor. [2+3+3]
 b) A 220V, series motor is running at a speed of 800 rpm and draw 100A. Calculate at what speed the motor will run developing half the torque. Total resistance of the armature and field is 0.1Ω . Assume that the magnetic circuit is unsaturated. [8]
5. a) Explain why the rotor core loss in a three phase induction motor is negligible. [4]
 b) Explain the effect of rotor resistance on the torque slip characteristics of induction motor? [4]
 c) Explain the rotor rheostat method of speed control of slipping induction motor with neat circuit diagram and T-S characteristic. [8]
6. a) Explain the process of synchronizing two 3 phase alternator with dark lamp method. [8]
 b) Explain the starting methods of synchronous motor? [8]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure (CT551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. ✓ Using resolution principle, prove that the hypotheses "If today is Tuesday then I will have a test in Discrete Structure or Microprocessor". If my Microprocessor teacher is sick then I will not have a test in Microprocessor." and "Today is Tuesday and my Microprocessor teacher is sick." lead to the conclusion that "I will have a test in Discrete Structure". [8]
2. Prove that $\sqrt{2}$ is irrational by giving a proof by contradiction. Draw the tableau for the formula $(T \vee S) \rightarrow \neg Q$ where \neg denotes the negation of variable, \vee denotes the disjunction of variables and \rightarrow is the symbol for implication. [5+3]
3. ✓ State the contrapositive and inverse of the conditional statement, "If it snows tonight then I will stay at home". Using mathematical induction technique, prove that the following statement is true: $3+3*5+3*5^2+\dots+3*5^n=3(5^{n+1}-1)/4$ whenever n is nonnegative integer. [2+6]
4. ✓ Differentiate between a Finite State Machine and a Finite State Automation. Design a Finite State Automata that accepts precisely those string over $\{a,b\}$ that contains an even no. of a's. Your design should include the proper definition of the Finite State Automata, transition table and the transition diagram. [2+6]
5. ✓ Consider the regular grammar $G = (N, T, P, \sigma)$ where N = set of non-terminal symbols = $\{\sigma, C\}$, T = set of terminal symbols = $\{a,b\}$, P is the set of production rules = $\{\sigma \rightarrow b\sigma, \sigma \rightarrow aC, C \rightarrow bC, C \rightarrow b\}$ and σ being the starting symbol. Construct a non-deterministic finite state automaton equivalent to given regular grammar. Use this non-deterministic finite state automaton to generate equivalent deterministic finite state automaton. [4+4]
6. ✓ Find all the solutions of the recurrence relation: [8]
 $a_n = 5a_{n-1} - 6a_{n-2} + 2^n$ with initial conditions $a_0 = 1$ and $a_1 = 4$
7. ✓ Explain the Euler path and Euler circuit with the help of a diagram. State the necessary and the sufficient conditions for Euler circuits and paths. [5+3]
8. ✓ Draw neat and clean graphs of: C_7 (a cycle with 7 vertices), K_5 (a complete graph with 5 vertices), Q_3 (a 3 dimensional hypercube) and $K_{3,4}$ (complete bipartite graph). Use graph coloring technique to color each of these graphs and state their respective chromatic numbers. [4+4]
9. ✓ Use Dijkstra's algorithm to find the length of shortest path in the following weighted graph. Also highlight the shortest path/paths in the graph: [8]



10. Write short notes on: [4+4]
 - i) Maximum Flow Mincut Theorem
 - ii) Handshaking Theorem

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure (CT551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- ✓ 1. Use resolution to show the hypothesis "It is not raining or Sita has her umbrella," "Sita does not have her umbrella or she does not get wet," and "It is raining or Sita does not get wet" imply that "Sita does not get wet." [8]
- ✓ 2. Use mathematical induction to show that [8]

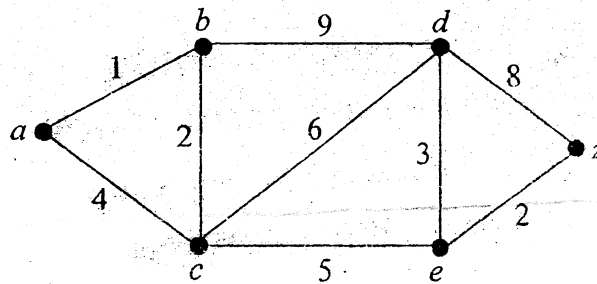
$$1^3 + 2^3 + \dots + n^3 = [n(n+1)/2]^2$$
 whenever n is a positive integer.
- ✓ 3. State the converse, contrapositive and inverse for the conditional statement, "I go to the beach whenever it is a sunny summer day." [3]
- ✓ 4. Why is a tableau method important in propositional logic? Draw the tableau for the formula [2+3]

$$\Phi = (p \wedge \neg q) \rightarrow s$$
 Where \neg denotes the negation of a variable, \wedge denotes the conjunction of variables and \rightarrow denotes the implication.
- ✓ 5. Differentiate between Finite State Machines and Finite State Automata. Design a Finite State Automata that accepts precisely those strings over $\{a, b\}$ that contain an odd number of b 's. Your design should include the proper definition of the finite-state automation, transition table and the transition diagram. [2+6]
- ✓ 6. Consider the regular grammar $G = (N, T, P, \sigma)$ where N = Set of Non-Terminals = $\{\sigma, A, B\}$, T = Set of Terminals = $\{a, b\}$ with productions. [4+4]

$$\sigma \rightarrow aA, \sigma \rightarrow bB, A \rightarrow a, B \rightarrow a$$
 and starting symbol σ .
 Construct a Non-Deterministic Finite State Automata equivalent to the above given regular grammar and convert this into equivalent Deterministic Finite State Automata.
- ✓ 7. Find all solutions of the recurrence relation [8]

$$a_n = 3a_{n-1} + 2^n$$
 with initial condition $a_0 = 5$.

8. Use Dijkstra's algorithm to find the length of the shortest path between the vertices a and z in the weighted graph displayed below. [8]



9. Draw the figure for the complete graph with 6 vertices (This is usually denoted by K_6). Define the term graph coloring and the chromatic number of a graph coloring. What is the chromatic number of the complete graph K_6 ? [2+2+2+2]
10. Explain the Hamiltonian path and Hamiltonian circuit with the help of a diagram. State the necessary and sufficient conditions for Euler circuits and paths. How is Euler circuit different from the Hamiltonian circuit? [3+2+2]
11. Write short notes on: [3+3+3]
- Spanning tree
 - Cutsets and Cutvertices
 - Application of trees

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INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure (CT551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. If $P = F, Q = T, S = T, R = F$, then find truth value of: [4+4]
 - ⑧ a) $(S \rightarrow (P \wedge \bar{R})) \wedge ((P \rightarrow (R \vee Q)) \wedge S)$
 - b) $((P \wedge \bar{Q}) \leftrightarrow (Q \wedge R)) \rightarrow (S \vee \bar{Q})$
2. Using rules of inferences, show that the hypothesis "It is not rainy today and its hotter than yesterday", "We will go for movie only if it is rainy", "If we do not go for movie, then we will go for shopping", and "If we go for shopping, then we will be home by sunset" lead to the conclusion "We will be home by sunset". You are required to show each steps and give reasons for those steps before you come to desired conclusion from the hypothesis. [8]
3. Prove by Mathematical Induction: [8]
 - ⑧ $1.2.3 + 2.3.4 + 3.4.5 + \dots + n(n+1)(n+2) = n(n+1)(n+2)(n+3)/4$
- +4. Design a Finite State Machines (FSM) that performs binary serial addition. Define DFA and NFA. Construct DFA that recognize the language "The set of bit strings that do not contain three consecutive 0's. Show only necessary figures and state diagrams. [3+2+3]
- ④ +5. Define and differentiate between context-sensitive, context free and regular grammars with suitable examples. Explain in short the role of regular expressions. [6+2]
- ⑥ 6. What do you understand by recurrence relation? Explain in brief. Derive and solve the recurrence relation for Tower of Hanoi puzzle. [2+6]
- ④ +7. Is $K_{3,3}$ graph a planar graph? Explain it with suitable reasons. [4+4]
- ⑥ 8. Define Regular and Bipartite graphs with suitable examples. [3+3]
- ② 9. Define level and height of tree? What is full m-ary tree and balanced tree? [2+2]
- ⑥ 10. State the handshaking theorem for the undirected graph and use it to prove the theorem that an undirected graph has an even number of vertices of odd degree. [2+4]
11. Write down the short notes on the following: [4+4]
 - ⑥ a) Maximum Flow Mincut Theorem
 - b) Graph Coloring

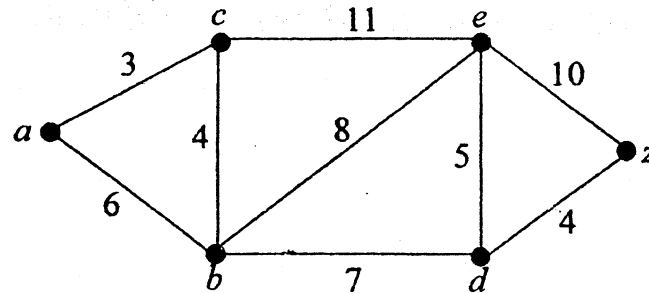
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure (CT551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Construct an argument using rules of inference to show that the hypotheses "Randy works hard," "If Randy works hard, then he is a dull boy," and "If Randy is a dull boy, then he will not get the job" imply the conclusion "Randy will not get the job." [8]
2. Use mathematical induction to show that
 $1^2 + 2^2 + \dots + n^2 = n(n+1)(2n+1)/6$
 whenever n is a positive integer. [8]
3. State the converse, contrapositive and inverse for the conditional statement, "A positive integer is a prime only if it has no divisors other than 1 and itself." [3]
4. Define satisfiable and unsatisfiable formulas. Draw the tableau for the formula
 $\Phi = \neg((p \wedge q) \vee r)$
 where \neg denotes the negation of a variable, \vee denotes the disjunction of variables and \wedge denotes the conjunction of variables. [2+3]
5. Define Finite State Machines. Design a Finite State Automata that accepts precisely those strings over $\{a, b\}$ that contain two consecutive a 's. Your design should include the proper definition of the finite-state automaton, transition table and the transition diagram. [2+6]
6. Consider the regular grammar $G = (N, T, P, \sigma)$ where N = Set of Non-Terminals = $\{\sigma, A, B\}$, T = Set of Terminals = $\{a, b\}$ with productions
 $\sigma \rightarrow a, \sigma \rightarrow bB, A \rightarrow bA, A \rightarrow aB, A \rightarrow b, A \rightarrow a, B \rightarrow b$ and starting symbol σ .
 Construct a Non-Deterministic Finite State Automata equivalent to the above given regular grammar and convert this into equivalent Deterministic Finite State Automata. [4+4]
7. Find all solutions of the recurrence relation
 $a_n = 2a_{n-1} + 2^n$
 with initial condition $a_0 = 2$. [8]

8. Use Dijkstra's algorithm to find the length of the shortest path between the vertices a and z in the weighted graph displayed below. [8]



9. Draw the figure for the complete graph with 5 vertices (This is usually denoted by K_5). Define the term graph coloring and the chromatic number of a graph in graph coloring. What is the chromatic number of the complete graph K_5 . [2+2+2+2]
10. Construct an influence graph for the board members of a company if the President can influence the Director of Research and Development, the Director of Marketing, and the Director of Operations; the Director of Research and Development can influence the Director of Operations; the Director of Marketing can influence the Director of Operations; and no one can influence, or be influenced by, the Chief Financial Officer. [4]
11. How is Euler circuit different from the Hamiltonian circuit? Explain [3]
12. Write short notes on [3+3+3]
- Spanning tree and its applications
 - Network Flows
 - Regular graphs

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure

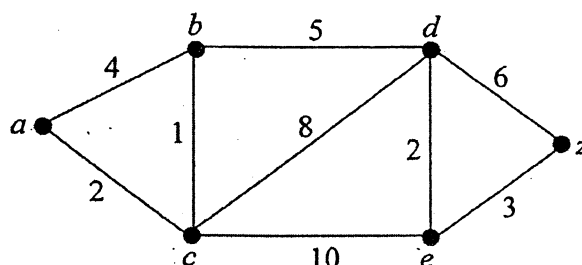
✓ Candidates are required to give their answers in their own words as far as practicable.

✓ Attempt **All** questions.

✓ The figures in the margin indicate **Full Marks**.

✓ Assume suitable data if necessary.

- Using rules of inferences, show that the hypotheses "If you send me an e-mail message, then I will finish writing the program," "If you do not send me an e-mail message, then I will go to sleep early," and "If I go to sleep early, then I will wake up feeling refreshed" lead to the conclusion "If I do not finish writing the program, then I will wake up feeling refreshed." You are required to show each steps and give reasons for those steps before you come to the desired conclusion from the hypotheses. (8)
- Use mathematical induction to prove that
 $3 + 3 \cdot 5 + 3 \cdot 5^2 + \dots + 3 \cdot 5^n = 3(5^{n+1} - 1) / 4$
 whenever n is a nonnegative number. (8)
- Prove that $\sqrt{2}$ is irrational by giving a proof by contradiction. Draw the tableau for the formula $(T \vee S) \rightarrow \neg Q$ where \neg denotes the negation of a variable, \vee denotes the disjunction of variables and \rightarrow is the symbol for implication. (5+3)
- Design a finite-state automaton that accepts only those set of strings over $\{a, b\}$ which starts with baa . Precisely, only those strings which begin with baa should be accepted and other strings over $\{a, b\}$ should be rejected. Your design should include the proper definition of the finite-state automaton, transition table and the transition diagram. (3+2+3)
- Discuss regular expressions and regular languages in detail with suitable examples. Explain the different properties of regular languages. (4+4)
- Find all solutions of the recurrence relation
 $a_n = 2a_{n-1} + 3^n$
 with initial condition $a_1 = 5$. (8)
- Use Dijkstra's algorithm to find the length of the shortest path between the vertices a and z in the weighted graph displayed below. (8)



- Draw the figure for the complete bipartite graph $K_{3,4}$ and the cycle graph with 5 vertices (This is usually denoted by C_5). What is the chromatic number of the drawn complete bipartite graph $K_{3,4}$ and the cycle graph C_5 . (2+2+2+2)
- State the handshaking theorem for the undirected graph and use it to prove the theorem that an undirected graph has an even number of vertices of odd degree. (2+4)
- Write short notes on: - (4+3+3)
 - Eulerian graph
 - Hamiltonian graph
 - Spanning tree

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Discrete Structure (CT551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- 1 Construct an argument using rules of inference to show that the hypotheses "If it does not rain or if it is not foggy, then the sailing race will be held and the lifesaving demonstration will go on," "If the sailing race is held, then the trophy will be awarded," and "The trophy was not awarded" imply the conclusion "It rained." You are required to show each step and give reasons for those steps before you come to the desired conclusion from the hypotheses. [8]

- 2 Use mathematical induction to prove the inequality $n < 2^n$ for all positive integers n . [8]

- 3 Why tableau method is important in the propositional logic? Draw the tableau for the formula set $\Phi = \{(p \wedge \neg q) \rightarrow s, \neg q \vee \neg r, p \wedge t\}$ where \neg denotes the negation of a variable, \vee denotes the disjunction of variables, \wedge denotes the conjunction of variables and \rightarrow denotes the implication. [2 + 6 = 8]

- 4 Differentiate between Deterministic Finite State Automata and Non-Deterministic Finite State Automata. Design a Finite State Automata that accepts precisely those strings over $\{a, b\}$ that contain an even number of a 's. Your design should include the proper definition of the finite-state automaton, transition table and the transition diagram. [2+6 = 8]

- 5 Consider the regular grammar defined by $T = \{a, b\}$, $N = \{\sigma, C\}$ with productions $\sigma \rightarrow b\sigma$, $\sigma \rightarrow aC$, $C \rightarrow bC$, $C \rightarrow b$ and starting symbol σ . Construct a Non-Deterministic Finite State Automata equivalent to the above given regular grammar and convert this into equivalent Deterministic Finite State Automata. [4 + 4 = 8]



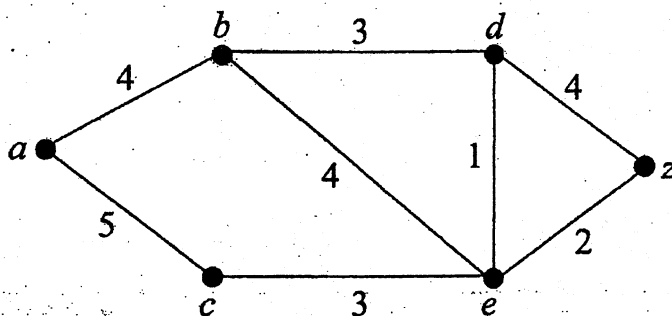
Find all solutions of the recurrence relation

$a_n = 7a_{n-1} - 16a_{n-2} + 12a_{n-3} + n4^n$
with initial condition $a_0 = -2$, $a_1 = 0$ and $a_2 = 5$.

[8]

- 7 Use Dijkstra's algorithm to find the length of the shortest path between the vertices a and z in the weighted graph displayed below.

[8]



- 8 Draw the figure for the complete bipartite graph $K_{4,5}$ and the cycle graph with 6 vertices (This is usually denoted by C_6). What is the chromatic number of the drawn complete bipartite graph $K_{4,5}$ and the cycle graph C_6 .

[2+2+2+2]

- 9 Define a tree and discuss its various properties as well as applications of trees.

[1+2+4=7]

- 10 Write short notes on: -

[3+3+3=9]

- a) Eulerian graph
- b) Max flow, min cut theorem
- c) Planar and regular graphs

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INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, B. Agri, BGE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Method (SH553)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- Discuss the difference between Absolute error and Relative error with examples. [4]
- Derive Newton Raphson iterative formula for solving nonlinear equation, using Taylor series. [4]
- Using the Bisection method, find a real root of the equation $f(x) = 3x - \sqrt{1 + \sin x}$ correct up to three decimal points. [8]
- Develop pseudocode to solve a system of linear equations using Gauss Jordan method. [8]
- Find the largest Eigen value and the corresponding Eigen vector of the following matrix using the power method with an accuracy of 2 decimal points. [8]

$$\begin{pmatrix} 1 & 2 & 1 \\ 2 & 1 & 2 \\ 1 & 2 & -1 \end{pmatrix}$$

- Using appropriate Newton's Interpolation Techniques, estimate $y(15)$ and $y(85)$ from the following data: [8]

x	10	30	50	70	90
y	34	56	45	23	36

- Fit the following data in to $y = a + b\sqrt{x}$ [8]

X	500	1000	2000	4000	6000
Y	0.20	0.33	0.38	0.45	0.51

- Write an algorithm to calculate the definite integral $\int_a^b f(x)dx$ using composite simpson's 1/3 rule. [4]

- The distance travelled by a vehicle at intervals of 2 minutes are given as follows: [6]

Time (min): 2 4 6 8 10 12

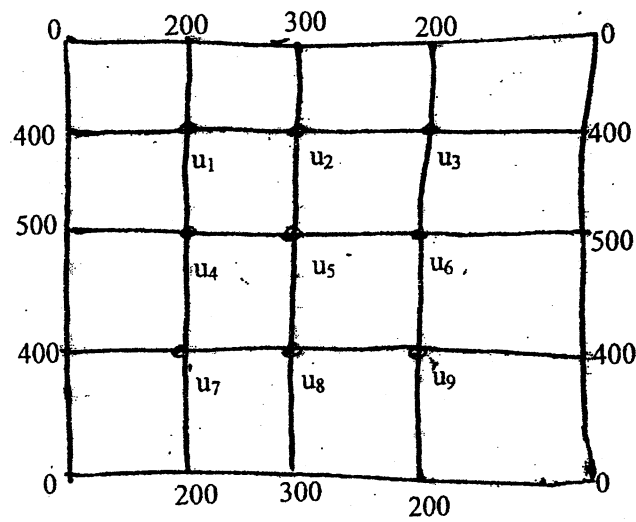
Distance (km): 0.25 1 2.2 4 6.5 8.5

Evaluate the velocity and acceleration of the vehicle at $t = 3$ minutes. [8]

- Solve the following by RK-2 method for $x = 0$ (0.1) 0.2

$$\frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = 0; y(0) = 1, y'(0) = 0$$

11. Solve the Laplace equation $u_{xx} + u_{yy} = 0$ for the square mesh with boundary values as shown in the figure. [10]



12. Derive Euler's formula for solving initial value problem. [4]

2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BGE, B.Agric.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Methods (SH553)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Create difference table from following data. [4]

X	3.0	3.2	3.4	3.6	3.8
Y	0.4771	0.5051	0.5315	0.5563	0.5798

2. Use bisection method to find a real positive root of $\sin x = \frac{1}{x}$ correct upto three decimal places. [8]

3. Write a pseudo-code to find a real root of a non-linear equation using Secant Method. [4]

4. Solve the following linear equations using Gauss Elimination or Gauss Jordan method using partial pivoting. [8]

$$2x + 3y + 2z = 2$$

$$10x + 3y + 4z = 16$$

$$3x + 6y + z = 6$$

5. Find the largest eigen-value and the corresponding eigen-vector of the following matrix. [8]

$$\begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$$

6. Find the best fit curve in the form of $y = a + bx + cx^2$ using least square approximation from the following discrete data. [8]

x	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	1.1	1.3	1.6	2.0	2.7	3.4	4.1

7. Use Lagrange's Interpolation formula to find the value of y when x = 3.0, from the following table. [8]

x	3.2	2.7	1.0	4.8	5.6
y	22.0	17.8	14.2	38.3	51.7

8. Evaluate $\int_0^2 f(x)dx$, for the function $f(x) = e^x + \sin 2x$ using composite Simpson's 3/8 formula taking step size $h = 0.4$. [5]

9. Evaluate $\int_0^2 \frac{dx}{x^2 + 2x + 1}$ using Gaussian 3 point formula. [5]

10. Solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ using RK - 4 method, for y(0.4). (Given, $y(0) = 1$, $h = 0.2$) [6]

11. Using the finite difference method, find y(0.25), y(0.5) and y(0.75) satisfying the differential equation $xy'' + y = 0$, subject to the boundary conditions $y(0) = 1$, $y(1) = 2$. [6]

12. Solve the Poisson equation $u_{xx} + u_{yy} = -81xy$, $0 < x < 1$, $0 < y < 1$ given that $u(0, y) = 0$, $u(x, 0) = 0$, $u(1, y) = 100$, $u(x, 1) = 100$ and $h = 1/3$. [10]

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Examination Control Division

2071 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BGE, B.Agr.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Method (SH553)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- Find a root of the equation $\cos x = xe^x$ using the regula-falsi method correct upto four decimal places. [8]
- Derive Newton-Raphson iterative formula for solving non-linear equation. [4]
- Define error. Discuss different types of errors in numerical computation. [4]
- Solve the following set of linear equations using LU factorization method. [8]

$$x - 3y + 10z = 3$$

$$-x + 4y + 2z = 20$$

$$5x + 2y + z = -12$$

- Use Gauss Seidel method to solve the following equations: [8]

$$20x + y - 2z = 17$$

$$3x + 20y - z = -18$$

$$2x - 3y + 20z = 25$$

- The following data are taken from the steam table. [8]

Temp. °C	140	150	160	170	180
Pressure kgf/cm ²	3.685	4.854	6.302	8.076	10.225

Find the pressure at the temperature $T = 142^\circ\text{C}$ and $T = 175^\circ\text{C}$ using Newton's interpolation.

- Derive expression for least square method of fitting a linear curve. [8]

OR

Develop pseudocode to interpolate the given set of data using Langrange interpolation.

- If 'x' is in cm and 't' is in time then find velocity and acceleration when $t = 0.1$ second. [4]

t	0	0.1	0.2	0.3	0.4	0.5	0.6
x	30.13	31.62	32.87	33.64	33.95	33.81	33.24

- Compute integration of the following function using Romberg integration $\int_{-1}^1 \frac{dx}{1+x^2}$. [6]

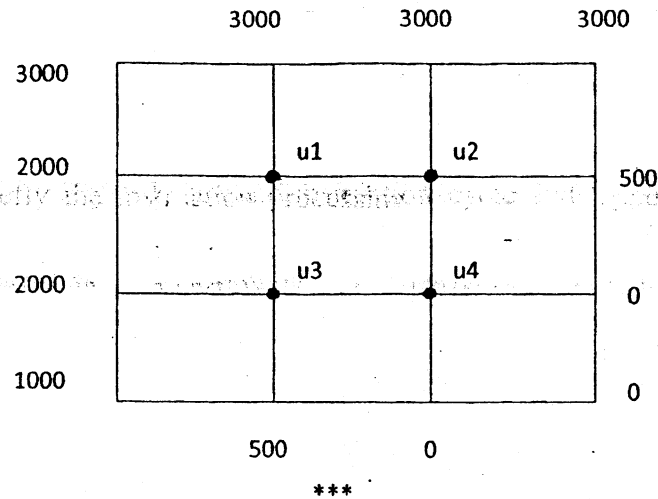
- Using Euler's method find $y(0.2)$ from following equation $y' = x + y$, $y(0) = 0$, take $h = 0.1$. [4]

11. Using the Runge-Kutta method of second order, obtain a solution of the equation $y'' = y + xy'$ with the initial condition $y(0) = 1$, $y'(0) = 0$ to find $y(0.2)$ and $y'(0.2)$. (Take $h = 0.1$)

[8]

12. Calculate the value of $u(x, y)$ satisfying the Laplace equation $\nabla^2 u = 0$ at the interior points of the square region with boundary conditions shown in figure below.

[10]



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Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, B.Agric.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Method (SH553)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Define error. Explain different types of errors in numerical computation. [6]
2. Find a real root of the following equation correct to four decimals using False Position method. [6]

$$e^{\cos x} - \sin x - 1 = 0$$

3. Discuss the limitations of Newton-Raphson method while finding a real root of a non-linear equation. [4]
4. Solve the following system of equations using LU factorization method. [8]

$$\begin{aligned} 5x_1 + 2x_2 + 3x_3 &= 31 \\ 3x_1 + 3x_2 + 2x_3 &= 25 \\ x_1 + 2x_2 + 4x_3 &= 25 \end{aligned}$$

5. Write an algorithm for solving a system of linear equations of 'N' unknowns using Gauss-Jordan Method. [8]
6. Find y at x = 8 from the following data using Natural Cubic Spline interpolation. [8]

x	3	5	7	9
y	3	2	3	1

7. Fit the following set of data to a curve of the form $y = a + bx$. Also evaluate y(7). [8]

x	2	4	6	8	10	12
y	16.0	11.1	8.7	6.4	4.7	2.6

8. Evaluate the following integral using Romberg method. [6]

$$\int_0^2 \frac{e^x + \sin x}{1+x^2} dx$$

9. Determine $y'(1)$ and $y''(1)$ from the following data. [4]

x	0.5	1.0	1.5	2.0	2.5
y	6	3	2	1.2	0.8

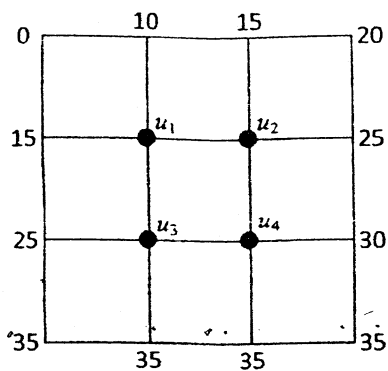
10. Solve the following initial value problem for y(1.2) using the Runge-Kutta fourth order method. [6]

$$y'' - 3y' + y = \sin x; \quad y(1) = 1.2; \quad y'(1) = 0.5$$

11. Write an algorithm to solve two point boundary value problem using shooting method. [6]

12. Solve $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary conditions as shown in figure below.

[10]



Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, B. Agri.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Method (SH553)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Generate forward difference table from the following data. [4]

x	1	2	3	4	5	6
f(x)	2	9	28	65	126	217

2. Explain the mechanism of finding a real root of a non-linear equation using secant method. [4]

3. Find a root of $e^x = 3x$ using bisection method and Newtons Raphson method correct upto 3 decimal places. [4+4]

4. Solve following system of linear equation using Gauss elimination method. [8]

$$\begin{aligned}x + 2y + 3z &= 6 \\2x + 3y + 5z &= 10 \\2x - y + 3z &= 4\end{aligned}$$

5. Write Pseudo- code to solve a system of linear equations of 'N' unknowns using Gauss-Jordan method. [8]

6. Use Lagrange method to find $f(2.5)$ from the following data : [8]

x	1	2	4	5	7
f(x)	1	1.414	1.732	2.00	2.6

7. Fit the following set of data to a curve of the form $y = a e^{bx}$ from the following observation by least square method. [8]

x	1	2	3	4	5	6
y	5.5	6.5	9.4	15.2	30.6	49.8

8. Derive the expression of Simpson's 1/3 rule for integration. [4]

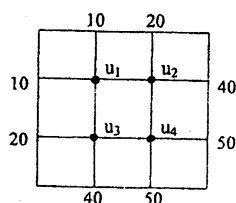
9. Evaluate: $\int_2^4 e^{-x^2} dx$ using 2-point Gauss Legendre method. [6]

OR

Evaluate $\int_1^2 e^{-x^2} dx$ using Romberg method correct up to 3 decimal places.

10. Solve: $y'' + xy' + y = 0$; $y(0) = 1$; $y'(0) = 0$ for $x = 0(0.1)0.2$ using the RK2 method. [10]

11. Solve the elliptic equation $u_{xx} + y_{xx} = 0$ for the following square mesh with boundary conditions as shown in figure below. [12]



Examination Control Division

2068 Bhadra

Exam:	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, B.Agri.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Numerical Methods

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- Find a real root of $x^5 - 3x^3 - 1 = 0$ correct up to four decimal places using the Secant Method. [8]
- Write a Pseudo-code to find a real root of a non- linear equation using Bisection Method. [4]
- Obtain the iteration formula of Secant method and explain its working procedure in finding a root of a non linear equation. [4]

OR

Explain the working principle of the bisection method to find a real root of a non-linear equation.

- Solve the following set of linear equations using a suitable iterative method. [8]

$$\begin{aligned} 2x + y + z - 2w &= -10 \\ 4x + 2z + w &= 8 \\ 3x + 2y + 2z &= 7 \\ x + 3y + 2z - w &= -5 \end{aligned}$$
- Find the largest eigen value and corresponding eigen vector of the following matrix, using power method [8]

$$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

- Find the values of y at $x = 1.6$ and $x = 4.8$ from the following points using Newton's interpolation technique. [8]

x	1	2	3	4	5
y	4	7.5	4	8.5	9.6

- Find a curve of the form $y = ab^x$ that fits the following set of observations using least square method. [8]

x	1	2	3	4	5
y	1.2	2.5	6.25	15.75	28.65

- The following table gives the angle in radians (θ) through which a rotating rod has turned for various values of time in seconds (t). Find the angular velocity and angular acceleration at $t = 0.2$. [4]

t	0	0.2	0.4	0.6	0.8
θ	0	0.122	0.493	0.123	2.022

9. Evaluate the integral $I = \int_{0.2}^{1.2} (\log(x+1) + \sin 2x) dx$, using Gaussian 2 point and 3 point formula. [6]

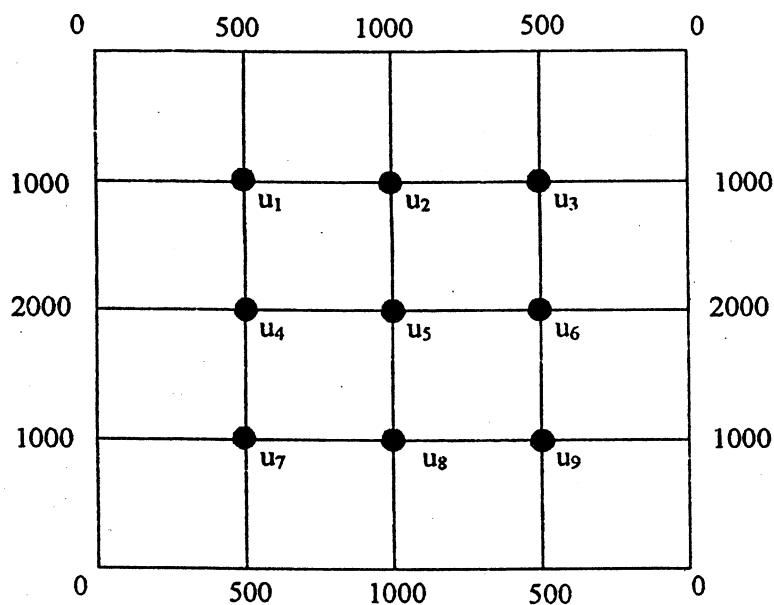
OR

Write a Pseudo-code to integrate a given function within given limits using Simpson's 3/8 rule.

10. Solve the differential equation, $\frac{dy}{dx} = (1+x^2)y$, within $x \leq 0(0.2)0.4$ and $y(0) = 1$ using RK 4th order method. [6]
11. Solve the following boundary value problem using the finite difference method, by dividing the interval into four sub-intervals. $\frac{d^2y}{dx^2} = x + y, y(0) = y(1) = 0$. [6]
12. Solve the equation $\nabla^2 u = -10(x^2 + y^2 + 10)$ over a square mesh with sides $x = 0, y = 0, x = 3, y = 3$ with $u = 0$ on the boundary and mesh length = 1. [10]

OR

Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the following square mesh with the boundary values as shown.



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Examination Control Division
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessor (EX551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is Bus? Explain Bus organization of microprocessor with diagram? Calculate the memory handling capacity of the processor having address bus of 24 lines and data bus of 16 lines. [1+5+2]
2. Explain the instruction format and data format of 8085 microprocessor. Explain different addressing modes of 8085 microprocessor. [3+5]
3. Write a program in 8085 to calculate the number of ones in the upper nibble of ten 8-bit numbers stored in a table. Store the count of ones in a location just after the table. [8]
4. What is statement in an assembly language program? Explain frequently used directives with suitable example. [2+6]
5. Write an assembly program to read a string from the user and display vowels and consonants separately. [8]
6. What do you understand by address decoding? Explain with example how PROM decoder is used in memory address decoding. [2+6]
7. Explain different modes of parallel data transfer. Explain briefly, what is PPI. [4+4]
8. What is interrupt? What is its importance in microprocessor? How interrupts from different peripherals can be handled with single INTR pin in 8086 microprocessor? Explain. [1+2+5]
9. What is register based and accumulator based architecture? Differentiate between CISC and RISC architecture? [2+6]
10. Write short notes on: [2×4]
 - a) DMA
 - b) INX, XTHL, MUL, JG

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Examination Control Division
2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessor (EX551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Draw and explain the block diagram of a computer. Explain stored program concept. [4+4]
2. What is flag? Discuss about 8085 associated flags. Along with suitable examples show how these flags are affected by arithmetic and logical group of instructions. [1+2+5]
3. Write a program for 8085 to generate multiplication table of a number stored at 8230H and store the generated table starting at 8231H. For example, if location 8230H has number 05H then store 05H at 8231 H, 0AH at 8232H and so on. [8]
4. Draw the internal architecture of 8086 microprocessor. Explain the function of each register accessible to programmer. [8]
5. Write a program in 8086 to read a string and display each word in a separate line in the center of the screen. [8]
6. Draw the timing diagram of STA instruction? Calculate the time taken to execute the following program if T = 1 micro second. [5+3]
MVI A,05H
ADI 20H
OUT 80H
HLT
7. Design an interfacing circuit to interface one 4 KB EPROM and two 2 KB R/W memory for 8085 microprocessor. [8]
8. What is IVT? How is it used to handle software and hardware interrupts? Explain. [2+6]
9. What is deadlock? What are the conditions for deadlock to occur? Write down the features of DSP chip. [1+3+4]
10. Write short notes on: [4×2]
 - a) RS 232
 - b) Two pass assembler

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessor (EX551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. ✓ Explain the microprocessor based system showing the bus organization. Explain the processing cycle of a stored program computer. [4+4]
2. ✓ Explain briefly the programmer's model of 8085 microprocessor. [8]
3. ✓ Write a program for 8085 to add the upper and lower nibble of ten 8 bit words stored in a table that starts from location 8B20H. Store the separate results in locations just after the table. [8]
4. ✓ What do you mean by addressing mode? Explain the addressing modes of 8086 with example. [3+5]
5. Write an assembly language program to read a text from keyboard, convert the text into uppercase and display on the cleared screen. [8]
6. ✓ Draw and explain the bus timing for OUT 42H instruction of 8085 microprocessor. [8]
7. ✓ Draw the address decoding circuit to interface two RAM memory block each of 8 KB at address C000H. [8]
8. ✓ Explain how hardware interrupt is processed in 8086 microprocessor. [8]
9. What do you mean by parallelism? Write and explain the features of a typical operating system. [8]
10. ✓ Write short notes on: [4×2]
 - a) ✓ RS 232 Standard
 - b) ✓ Programmable Peripheral Interface

10/17 M.

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INSTITUTE OF ENGINEERING
Examination Control Division
2071 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessors (EX551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- Define instruction cycle and machine cycle. Explain briefly the instruction processing cycle of Von Neumann machine. [4+4]
- Draw the internal architecture of 8085 microprocessor and explain each part. [8]
- Write an assembly language program for 8085. Table1 contains 16 no. of 8 bit data, transfer data which have number of 1s greater than 3, from table1 to table2, otherwise store FFH in table2. [8]
- What is statement in assembly language programming? Explain commonly used directives with examples. [8]
- Write a program to read a string and display only the alphabetic characters from the string in a clear screen. [8]
- Draw timing diagram of instruction LDA 2080H. Calculate the time required to execute this instruction if the crystal frequency is 6 MHZ. [6+2]
- Determine the capacity of devices in the following memory range. [2+6]

Range	Device
0000-1FFF	ROM
2000-3FFF	RAM1

Design an interfacing circuit to interface above memory devices with 8085 microprocessor.

- Define Interrupt Service Routine (ISR) and Interrupt Vector Table (IVT). Explain type 0 to type 4 interrupt of 8086. [2+6]
- What are the features of digital signal processors? Describe instruction level, thread level and process level parallelism. [2+6]
- Write short notes on: [4×2]
 - I/O mapped and memory mapped I/O
 - DMA

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INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessor (EX551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
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1. Define bus? Explain different types of bus. Define RTL. Write down the RTL for MOV r_1, r_2 in 8085 microprocessor. [4+4]
2. In how many ways 8085 instructions can be classified? Explain with examples. What is the purpose of the branching instructions? [6+2]
3. Write an assembly language program for 8085 to exchange the bits D6 and D2 of every byte of a program. Suppose there are 200 bytes in the program starting from memory location 8090H. [8]
4. Draw internal block diagram of 8086. Explain Bus Interface Unit. [5+3]
5. Write an assembly language program for 8086 to read string. Display each word in separate lines in a cleared screen, count how many words are there and display the count. [8]
6. Write the various machine cycle involved in LDA C030 stored at C050. Write the use of following pins of 8085 microprocessor. ALE, IO/M, READY, RD, AD₀-AD₇. [3+5]
7. Explain the execution of instruction LDA 8B7FH with the help of timing diagram. [8]
8. How interrupt vector table is used in microprocessors to manage the interrupt? Explain how software and hardware interrupts are used in 8086 microprocessor in detail. [3+5]
9. Write the conditions that may cause deadlock to arise. Explain Flynn's classification. [4+4]
10. Write short notes on: [4×2]
 - a) Hardwired and micro program control unit
 - b) EXE and COM programs

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2070 Magh

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Subject: - Microprocessor (EX551)

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- ✓ Attempt **All** questions.
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1. Differentiate between Hardwired and Microprogrammed Control Unit used in microprocessors? Write the fetch and execution cycle for LXI D,9050H instruction in RTL specifications. Explain each step. [4+4]
2. Write any three features of 8085 microprocessor. Explain the addressing modes of 8085 with example. [3+5]
3. Write an assembly language program in 8085 to divide a byte stored in memory location 9070 H by byte stored in 9071 H and store the remainder and quotient at 9072 H and 9073 H respectively. [8]
4. Draw the functional block diagram of 8086 microprocessor and explain each block. [8]
5. Write a program for 8086 to find the largest and smallest value from a list of ten 16 bit data and store the result in maxval and minval variables. [8]
6. What do you mean by serial interface? Differentiate between synchronous and asynchronous serial interlacing. Describe how we can use RS-232 standard to transfer data from DTE to DCE and vice versa? [1+3+4]
7. Design the address decoding interface of an input port and output port for 8085 at 81 H and 82 H address. Use block decoder. [8]
8. Differentiate Maskable and Non-Maskable interrupt. Write the general sequence to be followed when interrupt occurs. [2+6]
9. Write down the difference of RISC and CISC computers. [8]
10. Write short notes on: [2×4]
 - a) Serial and parallel interface
 - b) Programmable peripheral interface

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2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessor (EX551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
 - ✓ Attempt All questions.
 - ✓ The figures in the margin indicate Full Marks.
 - ✓ Assume suitable data if necessary.
- 1/ Define microprocessor based system. Explain the various components of a microprocessor based system including the bus structure. [2+6]
 - 2/ Compare CALL and RET instructions with PUSH and POP instructions for 8085. Illustrate their usages with appropriate examples. [4+4]
 3. Write a program to convert ten BCD numbers stored at 4350H to binary and store the result at 4360H. [8]
 4. Draw the internal architecture of the 8086 microprocessor. Differentiate between EXE and COM programs. [4+4]
 5. Write a program in 8086 to convert the vowels to uppercase from a string entered by the user and display the converted string in a new line. Also count the number of uppercase letters in the converted string and display the count in a new line. [8]
 - 6/ Define synchronous and asynchronous bus. Draw and explain the timing diagram of LXI B 1234H. [3+5]
 - 7/ Interface two 4K*8 ROM with 3:8 decoder at the address of your choice. Show the address map for each ROM and explain your circuit. [8]
 8. Explain how the interrupt vector table is used in 8086 microprocessor. Show the complete instruction execution sequence when interrupt service routine is called. [3+5]
 9. What do you mean by parallelism? Explain the case of deadlock that may arise during inter process communication. What role does the operating system play in handling such deadlocks? [2+3+3]
 10. Write short notes on: (any two) [2×4]
 - a) Flags in 8086 microprocessor
 - b) Programmable interrupt controller (PIC)
 - c) Instruction and machine cycles

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Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessors

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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- ✓ Assume suitable data if necessary.

- ✓ 1. What do you mean by stored program concept? Explain the processing cycle of stored program computer. [2+6]
- ✓ 2. Draw the block diagram of 8085 microprocessor and explain each part briefly. [8]
- ✓ 3. Write a program in 8085 to transfer 8-bit number from one table to other by setting bit D₅ if the number is less than 80H else transfer the number by resetting bit D₆. [8]
- ✓ 4. What do you mean by directives and instructions? Explain the frequently used directives in assembly language programming. [2+6]
5. Write a program in 8086 to read a string and count the number of vowels, consonants, numerals and other characters and display the count. [8]
- ✓ 6. What do you mean by synchronous and asynchronous bus? Draw the bus timing diagram for LXI B, 7492H which is stored in memory location 8200H. [2+6]
7. What do you mean by unique and non-unique address decoding? Explain memory mapped I/O along with an example. [2+6]
8. How is interrupt processing different than polling? Explain how interrupt processing is done with 8085. [2+6]
- ✓ 9. What do you mean by real and pseudo-parallelism? Explain Flynn's classification. [3+5]
10. Write short notes on [4×2=8]
 - a) Stack memory ✓
 - b) USART

Examination Control Division

2067 Mangsir

Exam.	Regular / Back		
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Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessors

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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1. What is a system bus? Explain different types of system buses. Compare 8085 and 8086 microprocessors system bus. [2+6+2]
2. What do you mean by an instruction? Explain different types of instructions in 8085 on the basis of function and instruction size with suitable examples. [2+8]
3. What is a flag? Describe status and control flags of 8086 in brief. Explain how 20 bit physical address is calculated from 16 bit logical address. Give suitable examples. [1+5+4]
4. A set of three readings is stored in memory starting at 9040H. Write an assembly language program to sort the readings in ascending order. Store the smallest value in address 9054H and so on in higher addresses. [10]
5. Write an assembly language program to read a string from memory in data segment. Change all the upper case letters to lower case and vice versa. Display the result on the screen. [Note: ASCII code for A = 65..... Z = 90, a = 97..... z = 122] [10]
6. In 8085, memory and I/O read/write instructions use extra machine cycle for memory and I/O read write operation. Use the bus time diagram for MOV R,M and out instructions to illustrate the statement. [5+5]
7. What is unique and non unique address decoding, explain with suitable examples. Design an unique address decoding circuit using memory mapped I/O interface to read input from port address FFF9H and output to port address FFF8H. [4+6]
8. Write short notes on: [2×5]
 - a) RIM and SIM instructions
 - b) RS 232

Amir Khan

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INSTITUTE OF ENGINEERING
Examination Control Division
2067 Shrawan

Exam.	Back		
Level	BE,	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessors

- ✓ Candidates are required to give their answers in their own words as far as practicable.
 - ✓ Attempt All questions.
 - ✓ The figures in the margin indicate Full Marks.
 - ✓ Assume suitable data if necessary.
-
1. Explain how instructions and opcodes are designed in microprocessor? What do you mean by register transfer language? What could be the register transfer statements for ADD B. 7 [3+2+5]
 2. Explain the following instructions in 8085 in detail with example
SBB B, DAD B, CPO 8285, XTHL, RST 5 [10]
 3. Write a program in 8085 to add all the numbers from a table of 8-bit numbers whose higher nibble value is greater than 6 and store the 16 bit result just after the table. [10]
 4. What do you mean by addressing mode? Explain different addressing modes of 8086 with example. 2 [2+8]
 5. Write a program in 8086 to read a single digit number and display the multiplication table of that number as
2 4 6 8 10 12 14 16 18 20 if user enters digit 2. 5- [10]
 6. What do you understand by synchronous bus and asynchronous bus? Draw and explain the bus timing diagram when the instruction ADI 34H is executed. 47 [3+7]
 7. Write down different ways of synchronizing peripherals with computer. Explain the interrupt processing mechanism vectored and polled interrupts. 7 [4+6]
 8. Write short notes on [5×2=10]
 - a) Stored program concept 3
 - b) Dynamic Memory Allocation

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Examination Control Division
2066 Magh

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessor

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain the features of automated calculator. Differentiate von-Neumann and Harvard architecture. [3+7]
2. What do you mean by instructions? How are instructions designed? Explain different addressing modes of 8085 along with the example. [2+2+6]
3. Write a program for 8085 to add corresponding data from two tables if the data from the first table is smaller than the second table else subtract data from the second table from the first table. Store the result of each operation in the corresponding location of the third table. Assume each table has ten eight-bit data. [10]
4. Draw the internal block diagram of the 8086 microprocessor. Explain the function of each component. [10]
5. Write an assembly language program to calculate the sum of the series $1^2 + 2^2 + 3^2 + 4^2 + \dots$ up to ten terms and display the result. [10]
6. What do you understand by machine cycle? What are the operations that are performed by the microprocessor? Draw and explain the timing diagram of STA 2050 instruction. [1+2+7]
7. What is the interrupt vector table? Explain polled and vectored interrupts. [4+6]
8. Write short notes on: [2x5=10]
 - a) RS232 Standard and Handshaking signals
 - b) RISC

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Examination Control Division
2065 Chaitra

Exam.	Regular/Back	
Level	BE	Full Marks 80
Programme	BEL, BEX, BCT	Pass Marks 32
Year / Part	II / II	Time 3 hrs.

Subject: - Microprocessors

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Differentiate microprocessors and microcontrollers. Compare 8085 and 8086 microprocessors in terms of programming models and addressing techniques. [2+6]

2. Write an assembly language program to count no. of -ve element in a data block containing 16 bytes of data; store the count at the end of the block if the count is greater than 8 otherwise store 0. [8]

3. What is flag? Describe the condition flags and control flags of 8086 briefly. Explain how 20 bit physical address is calculated from 16 bit logical addresses? [1+4+3]

4. Write an assembly language program to get a string input; count no. of vowels and display message 'even vowels' on the screen on the screen if the count is even otherwise display 'odd vowels'. [8]

5. An instruction is stored at memory location as follows: [8]

Memory Location	Hex Code
2050	3A (opcode)
2051	80
2052	20

This instruction loads the content of memory location 2080 into accumulator. Draw timing diagram of this instruction.

6. Present a complete plan to use 2 RAM chips of 16 KB each with 8085 microprocessor. [8]

7. How processor handles interrupt? Describe briefly hardware and software interrupts with example of each. [8]

8. Draw a simple block diagram of RISC and CISC architectures and describe merits and demerits of RISC and CISC computers. [8]

9. What is Asynchronous Communication? Describe RS-232A for serial communication. [2+6]

10. Write short notes on:

- a) Alternatives of semiconductor computing
- b) Memory mapped I/O and I/O mapped I/O

Exam.	Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessors

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- ✓ Attempt All questions.
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1. Draw the block diagram of 8085 microprocessor and explain different blocks. [10]
2. What is the purpose of the branching instructions? List out all the branching instructions in 8085 and explain each with example. [2+8]
3. What do you mean by statements in assembly language programming? Explain different directives used in assembly language programming. [2+8]
4. Write a program to transfer eight-bit numbers from 9080H to 9090H if bit D₅ is 1 and D₃ is 0. Otherwise transfer data by changing bit D₂ and D₆ from 1 to 0 or 0 to 1. Assume there are ten numbers. [10]
5. Write a program to generate multiplication table of five numbers stored in memory as array, store the result and display in following format. [10]

5 10 15 20 25 30 35 40 45 50
 3 6 9 12 15 18 21 24 27 30

6. What is unique and non unique address decoding, explain with suitable example. Design an address decoding circuit to interface an input device with eight input switches and a LED output device at 41H and 42H respectively. [4+6]
7. Explain how interrupt is processed in microprocessor systems. Differentiate between vectored and polled interrupts. [5+5]
8. Write short notes on: [2×5]
 - a) RS232 & RS423
 - b) RISC and CISC

Examination Control Division

2064 Poush

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Microprocessors

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain the instruction processing cycle of a microprocessor, instruction format and instruction sheet. Write down the history in the development of the microprocessor. [6+4]
2. What do you understand by looping? How can we perform looping in 8085 microprocessor, explain with example. Explain the mechanism of creating loops in creating delay loops of specified time. [2+2+6]
3. There are two tables T1, T2 in memory having ten eight bit data in each. Write a program for 8085 to find the difference of the corresponding element of these two tables. Store the result of each operation on the corresponding element of the third table. Remember that the result should not be negative; it should be $|T1 - T2|$. [10]
4. Write down the assembling linking and executing process. Explain macro assembling, one pass and two pass assemblers. [5+5]
5. Write down an assembly language program to read a string and count the no of vowels in the string. Display the no of vowels in the string and the string without the vowels in it in a clear screen with reverse attribute. [10]
6. What do you mean by address decoding? Differentiate between I/O mapped I/O and memory mapped I/O. Design an address decoding circuit to interface two RAM blocks and a ROM block each of 4 KB starting at address 4000H. [2+2+6]
7. Explain the interrupt processing operation for hardware and software in 8086 microprocessor. [10]
8. Write short notes on: [2×5]
 - a) Types of memory
 - b) Digital Signal Processor

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- ✓ Attempt All questions.
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- ✓ Assume suitable data if necessary.

1. Compare Harvard architecture with Von Neuman architecture. Explain which architecture 8085 microprocessor uses and how. [7+3]
2. What do you mean by stack and subroutine? What is the purpose of stack in subroutine call? Explain the concept of subroutine call and usage along with the changes in program execution sequence with a suitable example for 8085 microprocessor. [3+2+5]
3. What do you understand by addressing modes in microprocessor? Explain all the addressing modes of 8086 microprocessor with suitable example for each. [3+7]
4. Write a program for 8085 to convert and copy the lower case ASCII codes to upper case from memory location 9050H to 90A0H if any, otherwise copy as they are. Assume there are fifty codes in the source memory. [Note: ASCII Code for A=65...Z=90, a=97...z=122] [10]
5. Write an assembly language program for 8086 to read a string, count the number of vowels in the string and display the string and its vowels count in a clear screen. [10]
6. What are the different machine cycle operations of 8085 microprocessors? Write the bus timing cycle for IN and OUT instructions. [2+8]
7. What do you understand by address decoding? What are I/O mapped I/O and memory mapped I/O? Design an address decoding circuit for interfacing two RAM chips each of 256 bytes at address 5300H. [2+2+6]
8. Write short notes on: [2×5]
 - a) Vectored Interrupt
 - b) Dynamic Memory Allocation

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Instrumentation I (EE552)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. a) Distinguish between static and dynamic characteristic of a measurement system. Define the various parameter used to study these characteristics.
b) How an unknown inductance can be measured from Maxwell's Bridge circuit and Hay's Bridge circuit. Why these different bridge circuits are used for measurement of unknown inductance instead of using single Bridge circuit, Explain.
2. a) Define transducer with example. Explain the working principle of strain gauge and derive the expression for the gauge factor.
b) A barium titanate pickup has the dimensions of $5\text{mm} \times 5\text{mm} \times 1.25\text{mm}$. The force acting on it is 5N . The charge sensitivity of barium titanate is 150pC/N and its permittivity is $12.5 \times 10^{-9} \text{ F/m}$. if the modulus of elasticity of barium titanate is $12 \times 10^6 \text{ N/m}^2$, calculate the strain. Also calculate the charge and the capacitance.
3. a) Explain ideal characteristics of operation amplifier. Also explain different application of operational amplifier in measurement system.
b) Explain how data can be transferred by Optical Fiber Cable and write advantages of optical fiber communication.
4. a) What are the advantages of inverted R-2R DAC over others DAC? Derive its output expression for R-2R DAC.
b) What will be 6 bit successive approximation digital output of the analog input 6.127 V if V_R is 8V ? 410001
5. a) Explain the operating principle of electrical resonance type frequency meter in detail.
b) Show how the instrument transformers are used to measure high voltage and current. And also explain why the secondary of current transformer should not be kept open circuited while primary is energized.

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Subject: - Instrumentation I (EE552)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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- ✓ Assume suitable data if necessary.

1. a) Discuss the analog and digital measurement system with the help of their respective block diagrams. [6]
- b) An ac bridge circuit is working at 1000 Hz. Arm AB has $0.2 \mu\text{F}$ pure capacitance, arm BC has 500Ω pure resistance, arm CD contains an unknown impedance and arm DA has 300Ω resistance in parallel with $0.1 \mu\text{F}$ capacitor. Find the constant of arm CD considering it as a series circuit. [10]
2. a) What is loading effect of a potentiometer? Show that the error will be maximum when the slider of the potentiometer is at midpoint of the potentiometer. [8]
- b) Determine the thermoelectric sensitivity and emf developed in a thermocouple made of copper and constantan for a temperature of 50°C between its junction. Given that thermo electric emf of copper and constantan against platenium are $7.4 \mu\text{V}/^\circ\text{C}$ and $-34.4 \mu\text{V}/^\circ\text{C}$ respectively. [4]
- c) Explain how the flow of fluid can be measured by using Hot Wire Anemometers. [4]
3. a) Prove that "Linear relationship between capacitance and separation distance between two plates can be achieved by using differential arrangement". [8]
- b) Describe the construction and working of linear variable differential transformer for the measurement of displacement. [8]
4. a) Show how can an R-2R ladder network be used to generate a binary weighted sequence of current. [6]
- b) Highlight the advantages of optical fiber transmission over conventional data transmission system. [4]
- c) What is an instrumentation amplifier? Derive the expression for its gain. [6]
5. a) Explain the constructional detail and operating principle of a single phase induction type energy meter. [8]
- b) A 3-bit DAC has a voltage range of (0 - 12) V. Calculate the [8]
 - i) weight of LSB
 - ii) weight of MSB
 - iii) exact range of the converter
 - iv) percentage error

If now, the bit of the converter is increased to 6, show by how much amount the error is increased or decreased? Justify your answer.

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Exam.	Regular		
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Year / Part	II / II	Time	3 hrs.

Subject: - Instrumentation I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. a) Explain different component of measurement system with suitable examples. [4]
 b) A balanced AC bridge has the following constants [6]
 arm AB: $R = 1000 \Omega$ in parallel with $C = 0.5 \mu F$
 arm BC: $R = 1000 \Omega$ in series with $C = 0.5 \mu F$
 arm CD: $R = 200 \Omega$ in series with $L = 30 mH$
 Find the constant of arm CD. Express the result as a pure R in parallel with pure C or L.
 c) Using statistical analysis of random error of data measurement, explain how probable error in measurement can be obtained. [6]
2. a) Explain how can the response of capacitive transducer, which works on the principle of variation of capacitance with displacement between two plates, be made linear. Also give the sensitivity of such an arrangement. [6]
 b) Explain ideal characteristics of operation amplifier. Also explain different application of operational amplifier in measurement system. [6]
 c) A piezo-electric pressure transducer having sensitivity of $4 \times 10^{-12} C/N$ is connected to a charge amplifier, the gain being set to 10 mV/pc. The amplifier output is connected to a ultra-violet chart recorder whose sensitivity is set in such a way that the deflection of the chart recorder due to a force of 400 N is 100 mm. Find the overall sensitivity of the device and the sensitivity of the chart recorder. [4]
3. a) Explain how analog to digital conversion can be obtained by using flash ADC. [4]
 b) State and explain Nyquist criterion. Also explain the phenomenon of aliasing and the way to eliminate it. [4+2]
 c) Consider a 6-bit digital to analog converter with a resistance of $20 K\Omega$ in MSB position. The converter is designed with weighted resistive network. The reference voltage is 12 V. The output of the resistive network is connected to an operational amplifier with a feedback resistance of $10 K\Omega$. What is the analog output for a binary input of 101011? [4]
4. a) Describe the construction and working of a single phase induction type energy meter. Show that the total number of revolutions made by its disc during a particular time is proportional to the energy consumed. [8]
 b) Show how the instrument transformers are used to measure high voltage and current. [4]
 c) The basic step of a 9 bit DAC is 10.3 mV. If (000000000) represents 0 V, what O/P is produce if the input is (101101111)? Write the advantages of R-2R ladder type DAC over WRN type. [2+2]
5. a) List out different types of frequency meter. Explain the constructional detail and working principle of any one of them to measure frequency. [8]
 b) What do you understand by communication of data in an instrumentation system? Explain the principle of optical fibre data communication system and highlight its advantages over conventional data communication system. [8]

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Examination Control Division
2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Instrumentation I (EE552)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Distinguish between analog and digital system of measurement. [6]
 - b) A 0-150V voltmeter has guaranteed accuracy of 1% of full scale reading. The volt measured by this instrument is 75V and 37.5V. Calculate the possible percentage error of both readings. Comment upon the result. [4]
 - c) A balanced AC bridge has the following constants: [6]
 - arm AB, $R = 2000\Omega$ in parallel with $C = 0.047\mu F$
 - arm BC, $R = 1000\Omega$ in series with $C = 0.47\mu F$
 - arm CD, unknown R
 - arm DA, $C = 0.5\mu F$

The frequency of oscillator is 1000Hz. Find the constant of arm CD.
2. a) Obtain the balance equation for Hay's bridge and explain why it is most suitable for the measurement of inductance of a coil having high quality factor. [6]
 - b) Show how "Loading effect" causes a non linear relationship between the input and output in a measurement made by a potentiometer. Also prove that the maximum error occurs at the mid-point of the pot wire. [6]
 - c) A capacitive transducer is made up of two concentric cylindrical electrodes. The outer diameter of the inner electrode is 4mm and the dielectric medium is air. The inner diameter of the outer electrode is 4.1mm. Calculate the dielectric stress when a voltage of 100V is applied across the electrode. Is it within safe limit? The length of electrode is 20mm. Calculate the change in capacitance if the electrode is moved through a distance of 2mm. [4]
3. a) Describe the circuit of 3 amplifier configuration of an instrumentation amplifier. Also derive the expression for output voltage in terms of two input voltage. [6]
 - b) In order to measure the strain in a cantilever beam, a single strain gauge of resistance $2K\Omega$ and gauge factor 2 is mounted on the beam and connected to one arm of the bridge circuit. The other arms of the bridge have a resistance of $2K\Omega$ each. Calculate the detector deflection for 1000 micro-strain if the detector sensitivity is $10mm/\mu A$ and its internal resistance is: (i) 100Ω (ii) 200Ω . the supply to the bridge is 10V. [4]
 - c) Explain how digital to analog conversion can be achieved by using R-2R ladder network DAC. Discuss its advantages over WRN type of DAC. [6]

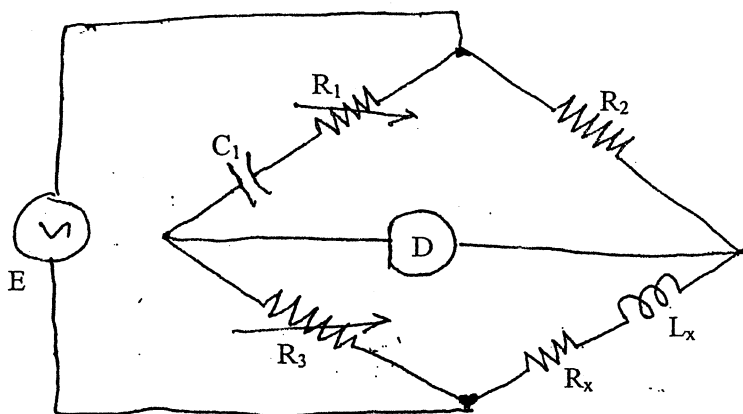
4. a) Describe in detail the successive approximation method of analog to digital (A/D) conversion taking an example of 4-bit converter having full range of 5V and input of 3.215V. [6]
- b) An 11-bit ADC has conversion time of $20\mu\text{s}$ and full scale voltage of 10V. Find the maximum rate of change of input signal and maximum input frequency that the analog input signal may have in order that the converter can resolve the input signal into 11-bit number in a signal conversion. [4]
- c) What is data acquisition system? Explain the function and objective of each component of an analog data acquisition system. [6]
5. a) Explain the construction and working principle of a single phase electro-dynamometer type of wattmeter and derive the expression of deflection for both ac and dc operation. [8]
- b) What do you understand by sample and hold circuit. Explain its functioning with the help of circuit diagram and also discuss about its characteristics to define its specification. [8]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Instrumentation I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Define measurement and measurement system. Also explain various types of errors encountered in electrical measurement. [8]
- b) The value of power consumed was determined by measuring current "I" flowing through the resistance with an error of ± 1.5 percent and resistance "R" with an error of ± 1 percent. Determine the maximum possible relative error to be expected on measuring power "P" from formula $P = I^2 R$. [8]
2. a) The AC bridge shown in the figure is used to measure the unknown induction (L_x) of a coil having quality factor greater than 10. Show that $L_x = R_2 R_3 C_1$, when the bridge is balanced. [8]



- b) Explain how low-resistance can be measured with the help of ammeter-voltmeter method. [8]
3. a) Explain the working principle of current transformer along with its connection in a circuit. What will happen if the secondary circuit of the current transformer is open circuited while the primary carries current? Explain. [8]
- b) The output of a potentiometer is to be read by a recorder of $10\text{ K}\Omega$ input resistance. Non-linearity must be held to 1 percent. A family of potentiometers having a thermal rating of 5 W and resistances ranging from 100Ω to $10,000\Omega$ in 100Ω steps are available. Choose, from this family, the potentiometer that has the greatest possible sensitivity and meets other requirements. What is the sensitivity if the potentiometer are single turn (360°) unit? [8]

4. a) Define piezo-resistive effect and gauge factor of a resistance strain gauge and derive the expression for the gauge factor. [10]
- b) A barium titanate piezo-electric pick-up has dimensions of $12\text{mm} \times 12\text{mm} \times 3\text{mm}$ and a voltage sensitivity of 0.015 Vm/N . Relative permittivity of barium titanate is 1400 and modulus of elasticity of barium titanate is $10 \times 10^{10} \text{ N/m}^2$. If the force applied is 20N, determine (i) the output voltage (ii) charge sensitivity (iii) strain (iv) charge generated (v) the capacitance of the pick up. [6]
5. a) Explain different applications of operational amplifier in measurement system. Also show that if a d.c. voltage is applied to an integrator it will produce a ramp voltage. [8]
- b) A 6-bit DAC has $20 \text{ K}\Omega$ resistance in MSB position. The converter is designed with weighted resistive network. The reference voltage is 12V. The output of the resistive network is connected to an operation amplifier with a feedback resistance of $5\text{K}\Omega$. What will be analog output for a binary input of 101101? [8]
6. a) Describe the construction details and working of a single phase electro-dynamometer type of wattmeter. Also derive the expression for deflection for ac operation. [10]
- b) A 10 bit, 10V successive approximation ADC has $20\mu\text{s}$ conversion time. Find the maximum rate of change of input signal and maximum input frequency. [6]

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Instrumentation I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Explain the function of different stages of measuring system with the help of block diagram. [8]
- b) Explain the "Loading effect" on the accuracy of resistance potentiometer transducer, when used for the measurement of displacement. [8]
2. a) What is an electrical transducer? How can it be classified, explain with suitable examples. [8]
- b) The value of resistance R was determined by measuring current I flowing through the resistance with an error of $\pm 1.5\%$ and power loss in it with an error of $\pm 1\%$. Determine the maximum possible relative error to be expected in measuring resistance R, calculated from the formula $R = P/I^2$. [4]
- c) "A precise instrument may not be accurate". Verify this statement with an appropriate example. [4]
3. a) Show that the sensitivity of a capacitive displacement transducer is non-linear when it works on the principle of change in distance between plates. Explain its constructional detail and working principle so as to obtain linear sensitivity. [8]
- b) A 6 bit DAC has a reference voltage of 9 volts if it uses: [8]
 - i) R-2R ladder network
 - ii) Weighted resistive network

Find the minimum value of resistance in both cases such that the output current does not exceed 10mA.
4. a) Obtain the balance equation for Maxwell Bridge for the measurement of inductance. Why this bridge is not suitable for measuring high – Q coils and also explain how it is modified to do so? [6]
- b) Explain with a suitable example, how analog to digital conversion is achieved by using successive approximation ADC. [6]
- c) An 8 bit A/D converter has a maximum supply voltage of 18 volts. Find: [4]
 - i) What voltage change does LSB represent?
 - ii) What voltage does 101011 represent?
5. a) Explain the operation of sample and hold circuit with its basic circuit and characteristic waveform to illustrate its specifications. What is the purpose of using sample and hold circuit in A/D conversion system? [8]

- b) Explain the working of an operational amplifier as: [4]
- i) an integrator
 - ii) a differentiator
- c) An op-amp is used as an integrator to produce a ramp voltage of -10V/ms . Design the circuit for this. [4]
6. a) What is a data acquisition system? What are the components of a digital DAS? Explain the working of a multiplexer with 4 input, 2 control and 1 output signal. [6]
- b) Write a short note on strip chart recorder. [4]
- c) Discuss the function of optical fiber communication link with the help of its block diagram. List out the advantages of optical fiber communication over conventional type of communication system. [6]

Examination Control Division

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Exam.	Regula	Back
Level	BE	Fi Iarks
Programme	BEL, BEX, BCT	Pass Marks
Year / Part	II / II	Time
		80
		32
		3 hrs.

Subject: - Instrumentation I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Distinguish between static and dynamic characteristics of a measurement system. Define the various parameters used to study static characteristics of a measurement system. [6]
- b) What is the difference between accuracy and precision? Explain. [6]
- c) Repeated measurements of the voltage necessary to cause the breakdown of dielectric gave following results: 38.9, 39.3, 38.6, 38.8, 39, 38.7, 39.4, 39.7, 38.4, 39, 39.1, 39.1 and 39.2 KV. Determine (i) average breakdown strength (ii) standard deviation of the readings. [4]
2. a) Explain one of the suitable transducer used for measurement of linear displacement. [6]
- b) Obtain the balance equation for Maxwell's bridge and explain why it can not be used for the measurement of inductance of a coil having high quality factor. [6]
- c) A capacitance transducer of two parallel plates of overlapping area $5 \times 10^{-4} \text{ m}^2$ is immersed in water. The capacitance has been found to be 9.5 pf. Calculate the separation distance between the plates and the sensitivity $S = \frac{\partial c}{\partial d}$ of the transducer. Given relative permittivity for water = 81. [4]
3. a) What is piezoelectric transducer? What are the materials used in such transducers? Define voltage sensitivity, charge sensitivity and derive the expression for the output voltage developed due to applied force. [6]
- b) The output relation for a thermister is given by [6]

$$R = R_0 e^{\beta \left(\frac{1}{T} - \frac{1}{T_0} \right)}$$

Where, value of resistance is R at temperature T°K in ohms, R_0 is the resistance at a reference temperature T°K in ohms, T is unknown temperature in °K. For $T_0 = 300^\circ\text{K}$, $\beta = 3420$, $R_0 = 1\text{K}\Omega$ and $R = 2\text{K}\Omega$. Calculate the value of T, find sensitivity, $S = \frac{\delta R}{\delta T}$ of a given operating point.
- c) Select a potentiometer that has the greatest possible sensitivity and meets the non-linearity requirement of 2% maximum from available potentiometers having a thermal rating of 10 watts and resistance ranging from 200Ω to $5\text{K}\Omega$ in steps of 50Ω . The output of potentiometer is to be measured with a device of 4000Ω input resistance. Also determine the maximum excitation voltage that can be employed with this potentiometer. [4]

4. a) What are the characteristics of an ideal operational amplifier? Derive the expression for closed loop gain of operational amplifier in inverting and non-inverting modes. [8]
- b) Explain how optical fibre can be used for the data transmission. Mention its advantages over other forms of data transmission. [8]
5. a) Describe with the help of block diagram and flow chart, the method of conversion of analog signal into digital one using successive approximation ADC. [8]
- b) A 6-bit DAC has reference voltage of 10V. Find the minimum value of resistance R such that the output current does not exceed 10 mA and also find the smallest value of quantized current if it uses [8]
- i) R-2R ladder network
- ii) weighted resistor network
6. a) Explain briefly the different components of digital data acquisition system. [8]
- b) What is recorder? Describe the components of magnetic tape recorder. What are its disadvantages? [8]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BGE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Applied Mathematics (SH551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) If $u = (x-1)^3 - 3xy^2 + 3y^2$, determine V so that $u + iv$ is an analytic function of $x+iy$. [5]
 b) Define an analytic function. Express Cauchy Riemann equations $u_x = v_y$ and $u_y = -v_x$ in polar form. [5]
2. a) Find the bilinear transformation which maps points $z_1 = 1, z_2 = i, z_3 = -1$ into the points $w_1 = i, w_2 = -1, w_3 = -i$ respectively. [5]
 b) Evaluate $\int_0^{1+i} (x^2 + iy)dz$ along the path $y = x^2$ [5]
3. a) Express $f(z) = \frac{1}{(z^2 - 3z + 2)}$ as Laurent's series in the region $1 < |z| < 2$. [5]
 b) Evaluate $\int_0^{2\pi} \frac{1}{5 - 4\sin\theta} d\theta$ by contour integration method in complex plane. [5]
4. a) Find z-transform of: [5]
 i) te^{-at}
 ii) $\sin at$
 b) State and prove final value theorem for z- transform. [5]
5. a) Find the inverse z-transform of $\frac{2z^2 - 5z}{(z-2)(z-3)}$ by using partial fraction method. [5]
 b) Solve difference equation $x(k+2) - 3x(k+1) + 2x(k) = 4^k$ for $x(0) = 0$ and $x(1) = 1$. [5]
6. Derive one dimensional wave equation and obtain its solution. [10]
7. Solve one dimensional heat equation: [10]

$$\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$$
 under the conditions:
 i) u is not infinite as $t \rightarrow \infty$
 ii) $\frac{\partial u}{\partial x} = 0$ for $x = 0$ and $x = l$
 iii) $u(x, 0) = lx - x^2$ for $t = 0$; between $x = 0$ and $x = l$
8. a) Find Fourier integral representation of $f(x) = e^{-x}, x > 0$ and hence evaluate

$$\int_0^\infty \frac{\cos(sx)}{s^2 + 1} ds$$
 [5]
 b) Find the Fourier cosine transform of $f(x) = e^{-|x|}$ and hence, by Parseval's identity, shown that

$$\int_0^\infty \frac{1}{(1+x^2)^2} dx = \frac{\pi}{4}$$
 [5]

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BGE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Applied Mathematics (SH551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Determine the analytic function $f(z) = u + iv$ if $u = \log \sqrt{x^2 + y^2}$.
2. State and prove Cauchy's integral formula.
3. Find the Taylor's series of $f(z) = \frac{1}{1-z}$ about $z = 3i$.
4. Evaluate the integral: $\oint_C \frac{z^2 dz}{(z+1)(z+3)}$ where $C: |z| = 4$, using residue theorem.
5. Define conformal mapping, show that $w = \frac{az+b}{cz+d}$ is invariant to

$$\left(\frac{w-w_1}{w-w_3} \right) \times \left(\frac{w_2-w_3}{w_2-w_1} \right) = \left(\frac{z-z_1}{z-z_3} \right) \times \left(\frac{z_2-z_3}{z_2-z_1} \right)$$
6. Using contour integration, evaluate real integral: $\int_{-\infty}^{+\infty} \frac{x^2 dx}{(x^2 + a^2)(x^2 + b^2)}$
7. Find the z-transform of $x(z) = \cosh t \sinh t$.
8. State and prove "final value theorem" for the z-transform.
9. Find the inverse z-transform of $x(z) = \frac{z}{z^2 + 7z + 10}$.
10. Using z-transform solve the difference equation:
 $x(K+2) + 6x(K+1) + 9x(K) = 2^K$; $x_0 = x_1 = 0$.
11. Derive one-dimensional heat equation.
12. Solve the wave equation for a tightly stretched string of length 'l' fixed at both ends if the initial deflection in $y(x, 0) = lx - x^2$ and the initial velocity is zero.
13. Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ under the conditions $u(0, y) = u(l, y) = u(x, 0) = 0$, $u(x, a) = \sin\left(\frac{n\pi x}{l}\right)$
14. Derive the wave equation (vibrating of a string).
15. Find the Fourier cosine transform of $f(x) = e^{-|x|}$ and hence show that $\int_0^{\infty} \frac{\cos py}{y^2 + \beta^2} dy = \frac{\pi}{2\beta} e^{-p\beta}$.
16. Find the Fourier integral representation of the function $f(x) = e^{-x}$, $x \geq 0$ with $f(-x) = f(x)$.
Hence evaluate $\int_0^{\infty} \frac{\cos(sx)}{s^2 + 1} ds$.

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BGE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Applied Mathematics (SH551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Determine the analytic function $f(z) = u + iv$ if $u = 3x^2y - y^3$. [5]
 b) Find the linear transformation which maps the points $z = 0, 1, \infty$ into the points $w = -3, -1, 1$ respectively. Find also fixed points of the transformation. [5]
2. a) State and prove Cauchy's integral formula. [5]
 b) Evaluate $\int_C \frac{e^{2z}}{(z-1)(z-2)} dz$ where C is the circle $|z| = 3$. [5]
3. a) Find the first four terms of the Taylor's series expansion of the complex function $f(z) = \frac{z+1}{(z-3)(z-4)}$ about the centre $z = 2$. [5]
 b) Evaluate $\int_C \frac{4-3z}{z(z-1)(z-2)} dz$ where C is the circle $|z| = \frac{3}{2}$. [5]

OR

Evaluate $\int_0^{2\pi} \frac{1}{\cos\theta + 2} d\theta$ by contour integration in the complex plane.

4. Derive one dimensional heat equation $u_t = c^2 u_{xx}$ and solve it completely. [10]
5. Find all possible solution of Laplace equation $u_{xx} + u_{yy} = 0$. Using this, hence solve $u_{xx} + u_{yy} = 0$, under the conditions $u(0, y) = 0$, $u(x, y) = 0$ when $y \rightarrow \infty$ and $u(x, 0) = \sin x$. [10]
6. a) Find the z-transform of $\sin K\theta$. Use it to find the $z[a^K \sin K\theta]$. [5]
 b) If $z[x(K)] = \frac{2z^2 + 3z + 12}{(z-1)^4}$, find the value of $x(2)$ and $x(3)$. [5]
7. a) Find the inverse z-transform of $x(z) = \frac{3z^3 + 2z}{(z-3)^2(z-2)}$ by using inversion integral method. [5]
 b) Using z-transform solve the difference equation $x(K+2) - 4x(K+1) + 4x(K) = 2^K$ given that $x(0) = 0$, $x(1) = 1$. [5]
8. a) Find the Fourier sine integral of the function $f(x) = e^{-Kx}$ and hence show that $\int_0^\infty \frac{\lambda \sin \lambda x}{\lambda^2 + \beta^2} d\lambda = \frac{\pi}{2} e^{-Kx}$, $x > 0, K > 0$ [5]
 b) Find the Fourier sine transform of e^{-x} , $x \geq 0$ and hence show that $\int_0^\infty \frac{x \sin mx}{x^2 + 1} dx = \frac{\pi}{2} e^{-m}$, $m > 0$ [5]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Instrumentation I (EE552)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Discuss the analog and digital measurement system with the help of their respective block diagrams. [6]
- b) An ac bridge circuit is working at 1000 Hz. Arm AB has $0.2 \mu\text{F}$ pure capacitance, arm BC has 500Ω pure resistance, arm CD contains an unknown impedance and arm DA has 300Ω resistance in parallel with $0.1 \mu\text{F}$ capacitor. Find the constant of arm CD considering it as a series circuit. [10]
2. a) What is loading effect of a potentiometer? Show that the error will be maximum when the slider of the potentiometer is at midpoint of the potentiometer. [8]
- b) Determine the thermoelectric sensitivity and emf developed in a thermocouple made of copper and constantan for a temperature of 50°C between its junction. Given that thermo electric emf of copper and constantan against platenium are $7.4 \mu\text{V}/^\circ\text{C}$ and $-34.4 \mu\text{V}/^\circ\text{C}$ respectively. [4]
- c) Explain how the flow of fluid can be measured by using Hot Wire Anemometers. [4]
3. a) Prove that "Linear relationship between capacitance and separation distance between two plates can be achieved by using differential arrangement". [8]
- b) Describe the construction and working of linear variable differential transformer for the measurement of displacement. [8]
4. a) Show how can an R-2R ladder network be used to generate a binary weighted sequence of current. [5]
- b) Highlight the advantages of optical fiber transmission over conventional data transmission system. [4]
- c) What is an instrumentation amplifier? Derive the expression for its gain. [6]
5. a) Explain the constructional detail and operating principle of a single phase induction type energy meter. [8]
- b) A 3-bit DAC has a voltage range of (0 - 12) V. Calculate the [8]
 - i) weight of LSB
 - ii) weight of MSB
 - iii) exact range of the converter
 - iv) percentage error

If now, the bit of the converter is increased to 6, show by how much amount the error is increased or decreased? Justify your answer.

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Applied Mathematics (SH551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Show that $u(x, y) = x^2 + 2xy - y^2$ is a harmonic function and determine $v(x, y)$ in such a way that $f(z) = u(x, y) + iv(x, y)$ is analytic. [5]
2. Define complex integral. State and prove Cauchy integral formula. [5]

OR

Obtain bilinear transformation which maps $-i, 0, i$ to $-1, i, 1$. [5]

3. Evaluate $\int_C \frac{e^{2z}}{(z-1)(z-2)} dz$ where C is $|z| = 3$ using Cauchy's integral formula. [5]
4. Obtain the Laurent series which represents the function $f(z) = \frac{z^2 - 1}{(z+2)(z+3)}$ $2 < |z| < 3$. [5]
5. Find the Laurent series of $f(z) = \frac{1}{4+z^2}$ about the point $z = i$. [5]
6. State and prove Taylor series of a function $f(z)$. [5]
7. Derive one dimensional wave equation $u_{tt} = c^2 u_{xx}$ and solve it completely. [10]
8. Solve one dimensional heat equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ under the boundary condition $\frac{\partial u}{\partial x} = 0$ when $x = 0$ and $x = L$ and initial condition $u(x, 0) = x$ for $0 < x < L$. [10]
9. Find Z transform of (a) te^{-at} and (b) $\sin at$. [5]
10. Find the inverse z-transform (a) $\frac{z-4}{(z-1)(z-2)^2}$ (b) $\frac{z}{z^2-3z+2}$. [5]
11. Obtain the Z transform of $x(t) = (1 - e^{-at})$, $a > 0$ and hence evaluate $x(\infty)$ by using final value theorem. [5]
12. Solve using z-transform the difference equation $x(K+2) + 2x(K+1) + 3x(K) = 0$. [5]
13. Find the Fourier sine transform of $f(x) = e^{-x}$, $x \geq 0$ and hence evaluate $\int_0^\infty \frac{x \sin x}{(1+x^2)} dx$. [5]
14. State and prove convolution theorem of Fourier transform. [5]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Applied Mathematics (SH551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Define analytic function. Show that the function $f(z) = \frac{1}{z^4}$ is analytic except $z = 0$ [5]

2. Define complex integral. Evaluate $\int_c \log z \, dz; c: |z| = 1$ [5]

OR

Obtain a bilinear transformation which maps $-i, 0, i$ to $-1, i, 1$.

3. Evaluate $\int_0^{1+i} (x^2 + iy) \, dz$ along the path $y = x$. [5]

4. Find the Taylor series of $f(z) = \frac{1}{4+z^2}$ about the point $z = i$. [5]

5. Evaluate the integrals by residue theorem $\int_c \frac{1 - \cos z}{z^3} \, dz$ [5]

6. State Cauchy's Residue theorem and use it to evaluate $\int_c \frac{z^2}{3+4z+z^2} \, dz$ where C is $|z| = 2$ [5]

OR

Evaluate $\int_0^{2\pi} \frac{d\theta}{\cos \theta + 2}$ by contour integration in complex plane.

7. Derive the one dimensional wave equation. [10]

8. A rod of length L has its ends A and B maintained at 0° and 100° respectively until steady state prevails. If the changes are made by reducing the temperature of end B to 85° and increasing that of end A to 15° , then find the temperature distribution in the rod at a time t . [10]

9. Find the z -transform of (i) $e^{-at} \sin \omega t$ (ii) $\cos at$ [5]

10. Obtain inverse Z -transform of (i) $\frac{z+2}{(z-2)(z-3)}$, (ii) $\frac{z}{(z-2)(z-1)}$ [5]

11. If $x(k) = 0$ for $k < 0$ and $Z\{x(k)\} = X(z)$ for $k > 0$ then prove that $Z\{x(k+n)\} = z^n X(z) - z^n \sum_{k=0}^{n-1} x(k)z^{-k}$ where $n = 0, 1, 2, \dots$ [5]

12. Solve the difference equation $x(k+2) - 4x(k+1) + 4x(k) = 0$ with conditions, $x(0) = 0, x(1) = 1$ [5]

13. Find the cosine transform of $f(x) = e^{-mx}$ $m > 0$ show that $\int_0^\infty \frac{\cos pr}{r^2 + B^2} = \frac{\pi}{2B} e^{-PB}$ [5]

14. Find the Fourier transform of $g(x) = \begin{cases} 1-x^2 & \text{if } -1 < x < 1; \\ 0, & \text{if otherwise.} \end{cases}$ [5]

and hence use it to evaluate $\int_0^\infty \left(\frac{x \cos x - \sin x}{x^3} \right) \cos(x/2) \, dx$

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INSTITUTE OF ENGINEERING
Examination Control Division.
2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Applied Mathematics (SH551)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

- Determine the analytic function $f(z) = u(x,y) + iv(x,y)$ if $u(x,y) = x^2 - y^2$.
- Define complex integral. Evaluate: $\oint_C (z+1)dz$ where C is the square with vertices at $z = 0, z = 1, z = 1+i$ and $z = i$.

OR

Find linear fractional transformation mapping of: $-2 \mapsto \infty, 0 \mapsto \frac{1}{2}, 2 \mapsto \frac{3}{4}$.

- State Cauchy's integral formula and evaluate the integral $\oint_C \frac{4-3z}{z(z-1)(z-2)} dz$, where C is circle $|z| = \frac{3}{2}$.

- Obtain the Laurent series which represents the function $f(z) = \frac{1}{(1+z^2)(z+2)}$ when $|z| < 2$.

- Find the Taylor's series expansion of $f(z) = \frac{1}{z^2 + 4}$ about the point $z = i$.
 - Evaluate $\int_C \tan z \, dz$ where C is a circle $|z| = 2$ by Cauchy's residue theorem.

OR

Evaluate $\int_0^{2\pi} \frac{\cos 3\theta}{5 - 4\cos\theta} d\theta$ by contour integration in the complex plane.

- Find the z-transforms of: (i) $\cos h(at) \sin(bt)$ (ii) $n.(n-1); n = k$
- Find the inverse z-transforms of: (i) $\frac{Z}{Z^2 - 3Z + 2}$ (ii) $\frac{Z}{(Z+1)^2(Z-1)}$.
- State and prove convolution theorem for z-transform.
 - Solve by using z-transform the difference equation $x(k+2) + 2x(k+1) + 3x(k) = 0$ given that $x(0) = 0$ and $x(1) = 2$

8. Solve $\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$ given that $u = 0$ as $t \rightarrow \infty$ as well as $u = 0$ at $x = 0$ and $x = l$.
9. Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$, which satisfies the condition $u(0, y) = u(L, y) = u(x, 0) = 0$ and $u(x, a) = \sin\left(\frac{n\pi x}{L}\right)$.

OR

The diameter of a semi-circular plate of radius a is kept at 0°C and the temperature at the semi-circular boundary is u_0 . Find the steady state temperature in the plate.

10. Find the Fourier integral representation of the function $f(x) = e^{-x}$, $x \geq 0$ with $f(-x) = f(x)$.

Hence evaluate $\int_0^\infty \frac{\cos(sx)}{s^2 + 1} ds$.

11. Find the Fourier transform of:

$$f(x) = 1 - x^2, |x| < 1$$

= 0, $|x| > 1$ and hence evaluate

$$\int_0^\infty \left(\frac{x \cos x - \sin x}{x^3} \right) \cos \frac{x}{2} dx.$$

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Applied Mathematics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. a) State necessary conditions for a function $f(z)$ to be analytic. Show that the function $f(z) = \log z$ is analytic everywhere except at the origin.

b) Find the linear fractional transformation that maps the points $z_1 = -i$, $z_2 = 0$ and $z_3 = i$ into points $w_1 = -1$, $w_2 = i$, $w_3 = 1$ respectively.

2. a) State and prove Cauchy's integral formula.

b) Write the statement of Cauchy's integral formula. Use it to evaluate the integral

$$\oint_C \frac{e^z}{(z-1)(z-3)} dz \text{ where } C \text{ is the circle } |z| = 2.$$

3. a) Write the statement of Taylor's theorem. Find the Laurent series for the function

$$f(z) = \frac{1}{z^2 - 3z + 2} \text{ in the region } 1 < |z| < 2.$$

b) State Cauchy-residue theorem. Using it evaluate $\oint_C \frac{\sin z}{z^6} dz$ where $C: |z| = 1$.

OR

Evaluate $\int_0^{2\pi} \frac{d\theta}{2 + \cos \theta}$ by contour integration in the complex plane.

4. a) Show that the Z-transform of $\cos k\theta$ is $\frac{z(z - \cos \theta)}{z^2 - 2z \cos \theta + 1}$. Use this result to find Z-transform of $a^k \cos k\theta$.

b) Obtain the inverse Z-transform of $\frac{2z^3 + z}{(z-2)^2(z-1)}$, using partial fraction method.

5. a) Solve the difference equation $x(k+2) - x(k+1) + 0.25x(k) = u(k)$ where $x(0) = 1$ and $x(1) = 2$ and $u(k)$ is unit step function.

b) State and prove shifting theorem of z-transform.

6. Derive one-dimensional wave equation governing transverse vibration of string and solve it completely.

7. Solve the one dimensional heat equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ under the conditions:

- a) u is not infinite as $t \rightarrow \infty$
- b) $\frac{\partial u}{\partial x} = 0$ for $x = 0$ and $x = l$ and
- c) $u(x, 0) = lx - x^2$ for $t = 0$ between $x = 0$ and $x = l$

OR

The diameter of a semi circular plate of radius a is kept at 0°C and temperature at the semi circular boundary is $T^\circ\text{C}$. Show that the steady temperature in the plate is given

$$\text{by } u(r, \theta) = \frac{4T}{\pi} \sum_{n=1}^{\infty} \frac{1}{2n-1} \left(\frac{r}{a}\right)^{2n-1} \sin(2n-1)\theta$$

8. a) Find the Fourier cosine integral representation of the function $f(x) = e^{-kx}$ ($x > 0, k > 0$) and hence show that

$$\int_0^{\infty} \frac{\cos \omega x}{k^2 + \omega^2} d\omega = \frac{\pi}{2k} e^{-kx} \quad (x > 0, K > 0)$$

- b) Obtain Fourier sine transform of e^{-x} , ($x > 0$) and hence evaluate $\int_0^{\infty} \frac{x^2}{(1+x^2)^2} dx$.

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Applied Mathematics

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Six questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. a) State Cauchy - Riemann equations in polar form. Show that $f(z) = \sin z$ is analytic in the entire z -plane.
b) State and prove Cauchy's integral formula.
2. a) State Laurent series. Find Taylor series of $f(z) = \cos z$ about $z = \frac{\pi}{4}$.
b) Define pole of order m . Find the residue of $f(z) = \frac{z^2 e^z}{(z-2)^3}$ at its pole.
3. a) Determine the Z-transform of
i) $t^2 e^{-at}$
ii) $e^{-at} \cos wt$
b) State initial value theorem for Z-transform. If Z-transform of a function is given by
$$X(z) = \frac{(1 - e^{-t})z^{-1}}{(1 - z^{-1})(1 - e^{-t}z^{-1})}$$
, determine $x(0)$, $x(1)$ and $x(2)$.
4. a) Find inverse Z- transform of
i) $x(z) = \frac{z+2}{z^2 - 5z + 6}$ (by partial fraction method)
ii) $x(z) = \frac{z+2}{z^2 + 7z + 10}$ (by inversion integral method)
b) Solve the difference equation: $x(k+2) - 4x(k+1) + 4x(k) = 0$ Where $x(0) = 1$ and $x(1) = 0$.
5. Derive one dimensional wave equation and obtain its solution.
6. Solve: $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ subject to the conditions, $u(0, y) = u(\ell, y) = u(x, 0) = 0$, and
$$u(x, a) = \sin\left(\frac{n\pi x}{\ell}\right).$$
7. Define convolution for Fourier transform. Verify convolution theorem for -
 $f(x) = g(x) = e^{-x^2}$.
8. Maximize: $z = x_1 + 3x_2$ subject to
$$x_1 + 2x_2 \leq 10, x_1 \leq 5, \text{ and } x_2 \leq 4; x_1, x_2 \geq 0$$

by using simplex method.

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Data Structure and Algorithm (CT552)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Define a data structure? Explain the basic data structure operations. [4]
2. What is a stack? Write an algorithm to convert infix expression into postfix expression using stack. [1+4]
3. Define a queue. Explain enqueue and dequeue operation in circuit queue. [1+4]
4. Differentiate static and dynamic implementation of list with suitable example. [6]
5. Define different types of linked list with suitable example. [5]
6. Write an algorithm creates a single linked list. [5]
7. Do you think recursive function is slow? Compare recursive and non-recursive functions. Draw recursion tree for Tower of Hanoi assuming 4 disks. [1+2+5]
8. Create an AVL balanced tree for the set of data 10, 20, 30, 35, 50, 70, 40, 80, 60, 65 by explaining each rotation rules used. [6]
9. Construct B-tree of order 5 for the set of data C N G A H E K Q M F W L T Z D P R X Y S showing each steps. [6]
10. Define a radix sort with its algorithm. Trace the steps to sort the following set of data using merge sort: 85, 76, 46, 92, 30, 41 and 12. [5+3]
11. How a linear probing, quadratic probing and double hashing techniques are used to resolve collision? Explain with suitable example. [8]
12. Define an Omega and Theta notation with suitable example. [4]
13. Explain a breadth first traversal in graph with suitable example. Explain Kruskal's algorithm to find minimum spanning tree with suitable example. [5+5]

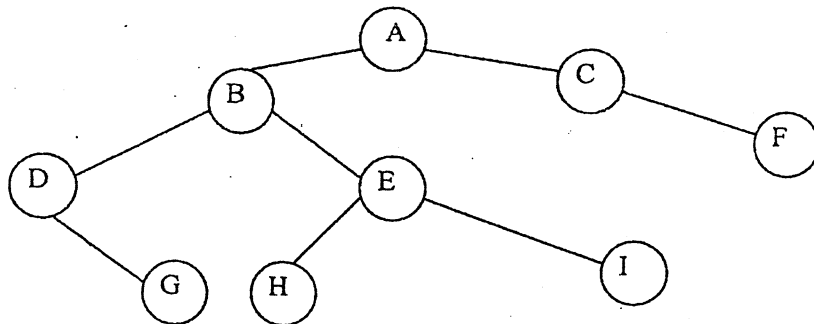
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Data Structure and Algorithm

- ✓ Candidates are required to give their answers in their own words as far as practicable.
 - ✓ Attempt All questions.
 - ✓ The figures in the margin indicate Full Marks.
 - ✓ Assume suitable data if necessary.
- Why data structures are needed? Write any data structure as ADT and write applications of stacks. [2+3+1]
 - Convert the following expression to postfix and prefix: [2+2]
 $((A+B)*C-(D-E))(F+G)$
 - Can you always insert an item into an empty queue? Explain with possible reasons and example? Explain the advantages of dynamic implementation of stack and queue over sequential storage to represent stack and queue. [3+2]
 - Write an algorithm to move one node to another place after a node in singly linear linked list. [6]
 - Explain recursion with its disadvantages? Draw the recursive tree diagram for the fibonacci sequence :fib(5). [1+1+3]
 - How can you compare either two sorting or two searching algorithms? Insert the following sequence of data into an AVL tree. [1+5]
 89, 35, 15, 87, 67, 76, 37, 14, 22, 25
 - Create the heap structure from the following sequence data: [11]
 12, 10, 1, 14, 6, 5, 8, 15, 3, 9, 7, 4, 11, 13 and 2 into an empty heap.
 And sort them using heap sort.
 - Why tree balancing is required? Insert the following keys to a 5-way B-tree: [1+7]
 3, 7, 9, 23, 45, 1, 5, 14, 25, 24, 13, 11, 4, 19, 8, 31, 35, 10, 13, 12
 - What is clustering? Explain any three collision resolving scheme with example if applicable. What are the differences between hashing and binary tree search? [2+6+2]
 - Explain the basic principle of quick sort and write down its partition algorithm. Compare quick sort and merge sort. Trace the sorting steps in radix sort algorithm for the following data: [3+2+5]
 12, 11, 30, 21, 25, 39, 36, 17, 29, 10, 26, 33, 7, 9

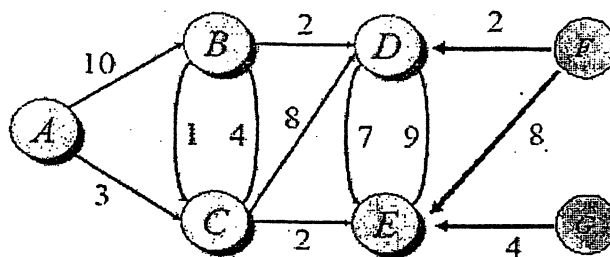
11. Write down the preorder, inorder and postorder traversal of the tree shown in the figure below.

[3]



12. What are the implementation differences between round robin and Kruskal's algorithms? Use Dijkstra's algorithm to find the shortest path from node A to other nodes given in the graph.

[1+5]

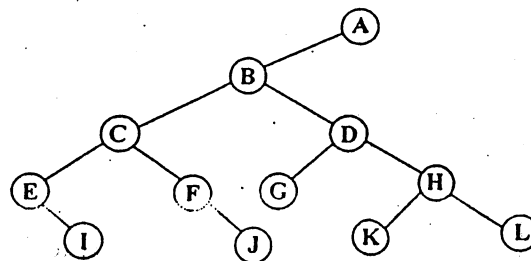


Exam.	Back		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Data Structures and Algorithms

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. Write an algorithm for converting infix expression to postfix expression. Convert a given infix expression: $A + (B * C - (D / E - F) * G) * H$ into postfix expression showing stack status after every step in tabular form. [4+4]
2. What are the demerits of simple linear queue? Write an algorithm to insert and remove data items for circular queue with the condition for queue full and empty. Trace your algorithm with an example. [2+4+2]
3. What are the types of linked list? Discuss the consideration that has to be taken while developing algorithm/program with a linked list. Why alias variables are dangerous in a linked list? Write an algorithm to delete the first node in a singly linked list. [1+4+1+2]
- ✓ 4. What are the types of recursion? Write an algorithm for Tower of Hanoi (TOH) and illustrate an algorithm for 3 disks. [2+2+4]
5. Define AVL balance tree and create AVL tree using AVL balancing algorithm for given sequence of data 3, 15, 21, 2, 7, 5, 13, 10, 8, 4, 19, 24, 1. Show inorder traversal of tree after each rotation clearly. [2+6]
6. Define a complete binary tree with an example. Write an algorithm for insertion of a node in binary tree. Write the sequence of node in preorder, inorder and postorder traversal for a given tree. [2+3+3]



7. Define internal and external sorting. Write an algorithm for quick sort and trace your algorithm for a given sequence of data. 5, 43, 99, 20, 45, 7, 6, 63, 92, 4. [1+4+3]
8. Define Big 'O' notation and describe the rules to determine the order of common functions. Compare linear, quadratic, logarithmic, linear logarithmic order functions. Compare the sequential search and binary search in terms of Big 'O' notation with an example. [1+3+2+2]
9. Define in-degree and out-degree in directed graph. Discuss the Depth First Traversal (DFT) and Breadth-First Traversal (BFT) with suitable examples. [2+6]
10. Write short notes on: [2×4]
 - a) Almost Complete Binary Tree
 - b) Transitive Closure Graph

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Data Structure and Algorithm

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. What do you mean by abstract data type? Write an algorithm for enqueue and dequeue operations in a queue. [2+3+3]
2. Define stack as an ADT? Convert the following infix expression onto prefix and post fix. [2+3+3]
 - a) $A + [B + C + (D + E) * F] / G$
 - b) $((a + b) * c - (d - e) * (f + g))$
3. What are linked list? Write an algorithm for inserting a node before a node and deleting a node after a node in singly linked list. [2+3+3]
- ✓ 4. "A junction or a object calls itself", Explain this statement using the idea behind it. Give recursive algorithm for Fibonacci series and TOH (tower of honoi). [3+2+3]
5. Give the recursive searching algorithm for BST (Binary Search Tree). Create AVL tree using following data sets. [4+4]

14, 12, 20, 18, 23, 4, 44, 64, 66

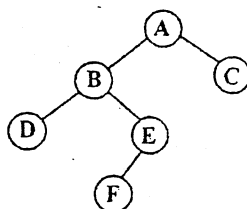
Show all the steps including rotation where ever needed clearly.
6. Define B-tree. Explain deletion process in B-tree using approximate examples and also discuss the efficiency of multi-waytree. [2+4+2]
7. What is internal and external sorting? Write an algorithm for shell sort. [2+6]
8. What is collision? Explain any two methods of collision resolution with reference to hashing. [1+7]
9. Define directed undirected graph, spanning forest, minimum spanning trees. [2+3+3]
10. Explain Dijkstra's algorithm for finding sortest path with the help of an algorithm. [8]

Programme	BCT	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

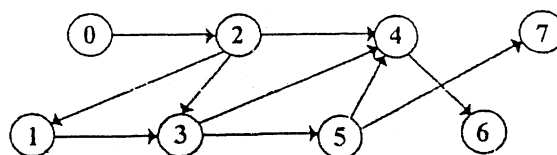
Subject: - Data Structures and Algorithms

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Define stack as an ADT. Write an algorithm for evaluating postfix expression. Evaluate a given postfix expression: 4 6 4 + * 8 / 4 - in tabular form showing stack after every step. [2+3+3]
2. What are the applications of queue? Write an algorithm for linear queue where both the head and tail pointer vary. Trace your algorithm with an example. [2+4+2]
3. Discuss the merits and demerits of contiguous list and linked list. Write algorithms to insert and delete a node after a node in a singly linked list. [3+5]
4. What is mean by recursion tree? Write recursive and iterative algorithms for Fibonacci number and compare and contrast the efficiency of two algorithms. Can every recursive problem be solved iteratively? [2+5+1]
5. Define B-tree and construct the B-tree for order 5 (i.e. $M = 5$) for given sequence of data 1,7,6,2,11,4,8,13,10,5,19,9,18,24,3,12,14,20,21,16, showing each steps. [2+6]
6. What are the types of rotations used in balancing an AVL tree? Discuss the rules for deciding which type of rotation to use to restore the balance in AVL tree. For a given binary tree, construct an AVL tree showing its inorder traversal after every step. [2+2+4]



7. What are the conflicting efficiency considerations in various sorting methods? Compare and contrast the efficiency of Bubble sort, Quick sort, Insertion sort and Selection sort algorithms with an example. [2+6]
8. Define hashing and hash collision. How do you minimize the hash collision? Write an algorithm for collision resolution by open addressing. [2+2+4]
9. Describe a strongly and weakly connected graph with suitable examples. Write algorithms for Depth-First and Breath-First topological sorting and trace your algorithms for a given acyclic directed graph. [3+5]



10. Write short notes on:

- a) Big 'O' notation
- b) Minimum cost spanning trees

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Data Structure and Algorithm

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is circular queue? Write an algorithm to implement circular queue with the condition for the queue full and empty. [2+4+2]
2. Write the merits and demerits of contiguous list and linked list. Discuss the implementation of stack array. [4+4]
3. Write recursive algorithm to convert prefix expression to post fix expression. Draw recursion tree and transform the following prefix expression to postfix. [3+5]
 - a) +-\$ABC*D**EFG
 - b) ++A-*\$BCD/+EF*GH
4. Discuss the application of multiway search tree. Define B-tree. Using the insertion algorithm of B tree. Create 3-order B tree for the given sequence of data. [3+2+3]

8,14,2,15,3,1,12,6,5
5. Write an algorithm to search a record in a binary search tree. If you want to search in the unsorted record in linear data structure, which searching algorithm will you choose? Discuss. [3+5]
6. What is doubly linked list and what are its features? Write the algorithms to delete a particular node in singly linked list. [1+1+6]
7. What do you mean by shortest path? Write the Dijkstra's algorithm and explain the algorithm with suitable example. [2+3+3]
8. Explain the basic principle of radix sort. Trace the sorting steps in quick sort and radix sort. [3+5]

25,57,48,37,12,92,86,33
9. Define heap structure. Construct heap for these elements 2,8,6,1,10,15,3,12,11. Show the steps clearly. [3+5]
10. How the depth first search algorithm and breadth first search algorithm are implemented? Explain with suitable example. [4+4]

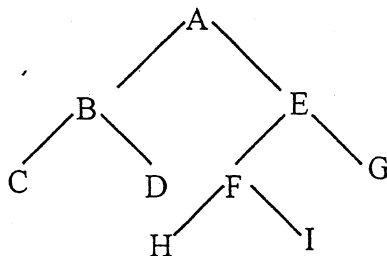
Exam.	Regular/Back		
Level	B.E.	Full Marks	80
Programme	BCT	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Data Structure and Algorithm

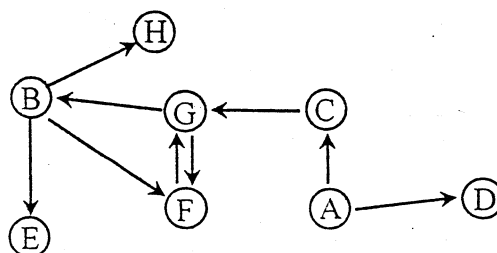
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Write an algorithm to delete a node before a node in singly and doubly linked list. [8]
2. a) Define abstract data type. Write the algorithm of enqueue and dequeue operations in circular queue. [1+3]
b) Convert the following infix expression into prefix and postfix expression. [4]
 - i) $a \$ b * c - d + e / f / (g + h)$
 - ii) $((a + b) * c - (d - e)) \$ (f + g)$
3. Discuss the efficiency of recursion. Draw the recursion tree for tower of Hanoi problem for 5 disks. Show execution path according to TOH algorithm. [3+5]
4. Define AVL balance tree.

Is the given tree in figure is strictly binary tree? Give reason. What is the depth of the given tree? Write the sequences of node in preorder, postorder and inorder traversal. [2+2+1+3]



5. Define B-tree. Create AVL tree using AVL balancing algorithm for the given sequence of data. 14, 12, 8, 18, 20, 23, 44, 52. Show the steps of balancing clearly. [2+6]
6. Write the algorithm of the quick sort including the steps of partition. Discuss the complexity of this algorithm. [5+3]
7. Define Big 'O' notation. Compare linear logarithmic, linear and quadratic order function. Explain which elementary sorting algorithm (i.e. Bubble, Insertion, Selection) you choose when the input data is in almost sorted form. [2+3+3]
8. Write an algorithm of depth first topological sorting. Create spanning tree using depth first traversal method of given graph. Show the steps clearly. [4+4]



9. Define clustering in rehashing method. Is it possible to remove clustering by quadratic probing? Explain. Outline an algorithm to delete a key from a hash table when the linear probing is used for inserting keys. [3+2+3]
10. Write an algorithm for the searching in multiway search tree. [8]