

6. A transformer operates most efficiently at $3/4^{\text{th}}$ full-load. Its iron loss (P_i) and full-load copper loss (P_c) are related as :
- (a) $P_i/P_c = 16/9$ (b) $P_i/P_c = 4/3$
(c) $P_i/P_c = 3/4$ (d) $P_i/P_c = 9/16$
7. The oil used in the transformer should be free from moisture because moisture will
- (a) reduce its density (b) reduce its dielectric strength
(c) cause its lubricating property to deteriorate (d) cause the transformer core to rust
8. In a shaded-pole induction motor, the rotor runs from the :
- (a) shaded portion to the unshaded portion of the pole while the flux in the former leads that of the latter
(b) shaded portion to the unshaded portion of the pole while the flux in the former lags that of the latter
(c) unshaded portion to the shaded portion while the flux in the former leads that in the latter
(d) unshaded portion to the shaded portion while the flux in the former lags that in the latter
9. Leakage flux in an induction motor is :
- (a) flux that leaks through the machine
(b) flux that links both stator and rotor windings
(c) flux that links none of the windings
(d) flux that links the stator winding or the rotor winding but not both
10. A 4-pole induction machine is working as an induction generator. The generator supply frequency is 60 Hz. The rotor current frequency is 5 Hz. The mechanical speed of the rotor in RPM is :
- (a) 1350 (b) 1650
(c) 1950 (d) 2250
11. In transformers, which of the following statements is valid?
- (a) In an open circuit test, copper losses are obtained while in short circuit test, core losses are obtained
(b) In an open circuit test, current is drawn at high power factor
(c) In a short circuit test, current is drawn at zero power factor
(d) In an open circuit test, current is drawn at low power factor
12. A single phase transformer has a maximum efficiency of 90% at full load and unity power factor. Efficiency at half load, at the same power factor is :
- (a) 86.7% (b) 88.26%
(c) 88.9% (d) 87.8%
13. The air-gap between the yoke and armature in a dc motor is kept small :
- (a) to achieve stronger magnetic field (b) to avoid overheating of the machine
(c) to avoid locking of the armature (d) to avoid transverse motion
14. Which one of the following relays has the capability of anticipating the possible major fault in a transformer?
- (a) Overcurrent relay (b) Differential relay
(c) Buchholz relay (d) Overfluxing relay
15. In pump storage hydropower plant, the electrical machine is made to work alternately as generator and motor. The efficiency of the generator working at the same electrical power level is :
- (a) greater than that as motor
(b) equal to that as motor
(c) less than that as motor
(d) greater or less than that as motor depending on the type of the machine

16. The concept of an electrically short, medium and long line is primarily based on the :
- (a) nominal voltage of the line
 - (b) physical length of the line
 - (c) wavelength of the line
 - (d) power transmitted over the line
17. The critical clearing time of a fault in power system is related to :
- (a) Reactive power limit
 - (b) Short-circuit limit
 - (c) Steady state stability limit
 - (d) Transient curves
18. Bulk power transmission over long HVDC lines are preferred, on account of :
- (a) low cost of HVDC terminals
 - (b) no harmonics problems
 - (c) minimum line power losses
 - (d) simple protection
19. Power transmission lines are transposed to reduce :
- (a) Skin effect
 - (b) Ferranti effect
 - (c) Transmission loss
 - (d) Interference with neighbouring communication lines
20. The economics of power plant is greatly influenced by :
- i. load factor
 - ii. utilization capacity
 - iii. unit capacity
 - iv. type of load
- (a) i, ii, iii and iv
 - (b) i, iii and iv
 - (c) i, ii and iv
 - (d) ii, iii and iv
21. The restriking voltage is measured in :
- (a) RMS value
 - (b) Peak value
 - (c) Instantaneous value
 - (d) Average value
22. Which of the following power stations is mainly used to cover peak load on the system?
- (a) Coal based thermal power plant
 - (b) Nuclear power plant
 - (c) Gas based thermal power plant
 - (d) Pumped storage hydro power plant
23. Introduction of negative feedback in a system does not lead to reduction in :
- (a) bandwidth
 - (b) distortion
 - (c) instability
 - (d) overall gain
24. Bandwidth is used as means of specifying performance of a control system related to :
- (a) relative stability of the system
 - (b) the speed of response
 - (c) the constant gain
 - (d) time response
25. In most systems, an increase in gain leads to :
- (a) large damping ratio
 - (b) smaller damping ratio
 - (c) constant damping ratio
 - (d) none of these
26. Conditionally stable system is one which exhibits poor stability at :
- (a) increases values of open-loop gain
 - (b) reduced values of open-loop gain
 - (c) low frequencies
 - (d) increas values of close loop

27. In Routh-Hurwitz criterion, if there are changes of signs in the elements of the first column, then the number of sign changes indicates :
- (a) the number of roots with negative real parts (b) the number of roots with positive real parts
(c) the number of pair of roots of opposite sign (d) the number of pairs of roots of same sign
28. The system with the characteristic equation, $(s+1)(s+2)(s-3)=0$ is :
- (a) stable (b) marginally stable
(c) not necessarily stable (d) unstable
29. The best method for determining the stability and transient response is :
- (a) Bode plot (b) Nyquist plot
(c) Root locus (d) None of these
30. Which of the following is used for Nyquist plot?
- (a) Characteristic equation (b) Open-loop function
(c) Close-loop function (d) None of these
31. The speed of d.c motor is :
- (a) directly proportional to back e.m.f and inversely proportional to flux
(b) inversely proportional to back e.m.f and directly proportional to flux
(c) directly proportional to e.m.f as well as flux
(d) inversely proportional to e.m.f as well as flux
32. A simple method for increasing the voltage of a d.c generator is :
- (a) to decrease the air gap flux density (b) to increase the speed of rotation
(c) to decrease the speed of rotation (d) to increase the length of the armature
33. Which of the following motors is used to derive the constant speed line shafting lathes, blowers and fans?
- (a) D.C shunt motor (b) D.C series motor
(c) Commutative compound motor (d) None of these
34. If the back e.m.f of a d.c motor is absent, then :
- (a) motor will run at very high speed (b) motor will run at very low speed
(c) motor will not run at all (d) motor will burn
35. A transformer has a turn ratio of 1:10 and a resistance of 5000 ohms is connected across the secondary terminals, the resistance offered to a current flowing in the primary will be :
- (a) 50 ohms (b) 500 ohms
(c) 5000 ohms (d) 50 kilo ohms
36. Two transformers are operating in parallel. They will share the load depending upon their :
- (a) Efficiency (b) Rating
(c) Leakage reactance (d) Per-unit impedance
37. During short circuit test, the iron loss of a transformer is negligible because :
- (a) the entire input is just sufficient to meet copper loss only
(b) voltage applied across the H.V side is a small fraction of the rated voltage and so is the flux
(c) iron core becomes fully saturated
(d) supply frequency is held constant
38. The conditions for running two alternators in parallel are :
- (a) terminal voltage should be same (b) frequency should be same
(c) phase sequence should be same (d) all of these

39. A synchronous motor can run at :
- (a) a leading power factor
 - (b) unity power factor
 - (c) lagging or leading or unity power factor
 - (d) zero power factor
40. If a synchronous motor is switched on to 3-phase supply with its rotor winding short circuited, it will
- (a) start
 - (b) not start
 - (c) start and continue to run as induction motor
 - (d) start and continue to run as synchronous motor
41. If any two phases of the 3-phase supply are interchanged, then the motor will :
- (a) still run in the same direction
 - (b) stop running
 - (c) run in the reverse direction
 - (d) draw high current
42. The speed of a 50 Hz induction motor under full load conditions is 720 r.p.m. The numbers of poles of the motor are :
- (a) 4
 - (b) 2
 - (c) 8
 - (d) none of these
43. The overall thermal efficiency of a thermal power plant lies in the range :
- (a) 25% to 30%
 - (b) 35% to 40%
 - (c) 45% to 60%
 - (d) 65% to 80%
44. The corona effect can be minimised by increasing :
- (a) the length of the conductor
 - (b) spacing between conductors
 - (c) diameter of the conductors
 - (d) both spacing between conductors and diameter of the conductor
45. Series capacitor are used for improving line :
- (a) capacitive reactance
 - (b) inductive reactance effect
 - (c) voltage
 - (d) regulation
46. Ferranti effect on long overhead lines is experienced when :
- (a) the line is lightly loaded
 - (b) the power factor is unity
 - (c) the power factor is leading
 - (d) corona effect is dominant
47. If the supply frequency increases, the skin effect is :
- (a) decreased
 - (b) increased
 - (c) remain same
 - (d) fluctuate
48. Zero sequence component always flows through :
- (a) phase wire
 - (b) neutral wire
 - (c) earth wire
 - (d) none of the above
49. If the dielectric strength of the medium between contacts builds up more rapidly than the re-striking voltage, then the arc will :
- (a) be extinguished
 - (b) not be extinguished
 - (c) increase
 - (d) will not change
50. If the fault current is 2000 amps, the relay setting is 50% and CT ratio is 400/5, the plug setting multiplier will be :
- (a) 8
 - (b) 10
 - (c) 12
 - (d) 15

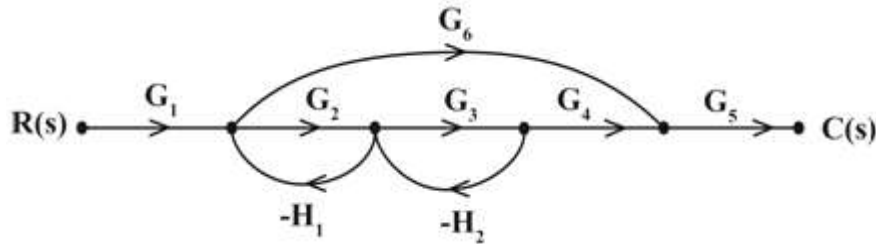
SECTION - B (Short answer type question)

(100 Marks)

All questions carry equal marks of 5 each.

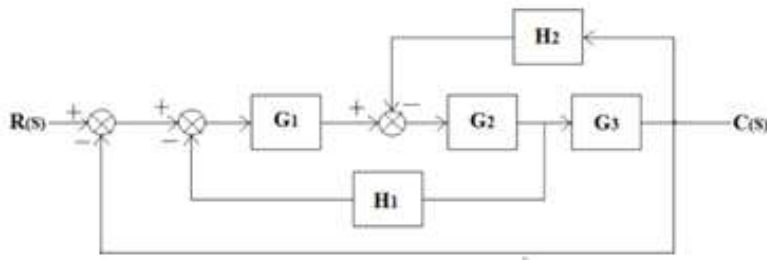
This Section should be answered only on the Answer Sheet provided.

1. The signal flow graph of a feedback control system is shown below. Determine its closed loop transfer function.



2. A 220V d.c shunt motor runs at 500 r.p.m when the armature current is 50A. Calculate the speed if the torque is double. Given that $R_a=0.2\Omega$.
3. A 25KVA transformer has 500 turns on primary and 50 turns on the secondary winding. The primary is connected to 3000V, 50Hz supply. Find the full load primary and secondary currents, the secondary e.m.f and the maximum flux in the core. Neglect leakage drops and no-load primary current. **(1.25×4=5)**
4. (a) How do changes in supply voltage and frequency affect the performance of a 3 phase induction motor? How does slip vary with load? **(3)**
 (b) What modification would be necessary if a 3 phase induction motor is required to operate on voltage different from that for which it was originally designed? **(2)**
5. (a) A 3-phase synchronous motor has 12 poles and operates from 440V, 50Hz supply. Calculate its speed. If it takes a line current of 100A at 0.8 power factor lead, what torque the motor will be developing? Neglect losses. **(3)**
 (b) Does change in excitation affect the synchronous motor speed? Is the efficiency of synchronous motor higher than induction motor? **(2)**
6. A star connected 3-phase, 10MVA, 6.6KV alternator is protected by Merz-price circulating current principle using 1000/5 amperes current transformers. The star point of the alternator is earthed through a resistance of 7.5Ω . If the minimum operating current for the relay is 0.5A, calculate the percentage of each phase of the stator winding which is unprotected against earth fault when the machine is operating at normal voltage.
7. Estimate the distance over which a load of 15000KW at 0.8 lagging power factor can be delivered by a 3-phase transmission line having conductors each of resistance 1Ω per kilometre. The voltage at the receiving end is to be 132KV and the loss in the transmission is to be 5%.
8. A single phase line is transmitting 1100KW power to a factory at 11KV and at 0.8 pf lagging. It has a total resistance of 2Ω and a loop reactance of 3Ω . Determine the voltage at the sending end and transmission efficiency. **(2.5+2.5=5)**

9. Obtain the transfer function of the system given below using block diagram reduction techniques.



10. What is frequency response? What is resonant peak of a frequency domain response? Derive the expression for resonant peak and resonant frequency.
11. Explain, briefly, the working principle of a single induction motor with the help of double revolving field theory.
12. Derive the torque equation of a DC Motor.
13. What do you understand from the term armature reaction? Describe the role of compensating windings in a DC generator with relevant diagrams?
14. Discuss in detail how 'V' curves is obtained for a synchronous motor.
15. Explain the build-up process of voltage of a DC generator. Mention the different reasons of failure to building up process of DC shunt generator.
16. How do you define load factor, diversity factor, and plant use factor? What steps would you suggest to improve the load factor of a system whose load factor is abysmally low?
17. Explain the importance of bus impedance matrix in fault calculation.
18. What are pumped storage plants? Describe with neat sketches the principle of operation of such a plant.
19. What are the symmetrical components? Explain briefly with the help of vector diagram the positive, negative and zero sequence quantities.
20. In a power system, power is supplied to a short-line through transformer connected to bus-bar. If a line-to-ground fault occurs on one of the lines and is cleared by a circuit breaker close to transformer (on line side), derive the expression for restriking voltage and its natural frequency.

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