

BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR
B.E. 3RD SEMESTER (MIN) FINAL EXAMINATION, 2011
Subject : Electro-Technology in mining (EE 307)

Full Marks: 70

Time: 3 hrs

- (i) Use separate answer script for each half
- (ii) The questions are of equal value
- (iii) Answer any six questions taking three from each half
- (iv) **Two marks** reserved for neatness in each half

FIRST HALF

1. a) What is a 'PILSDWA cable'? Draw the cross sectional view of a three-phase cable of this kind. What is the drawback of such a cable? (1 + 2 + 2)
b) What are the advantages of PVC insulation over impregnated paper insulation? (2)
c) For a single-core 200 A cable, the current density in the conductor is 2 A/mm². Assuming that a 3-layer stranded conductor is used with a space factor of 0.9, find the radius of each strand. (4)
2. a) What is meant by a 'cradle separator' in connection with a trailing cable? Name two commercially used trailing cables. (2 + 2)
b) Distinguish between sheath and armour, clearly stating the materials used to manufacture each. (4)
c) What is the relationship of insulation thickness of a cable with the maximum dielectric stress permissible for that insulation? (3)
3. a) What are 'intrinsically safe barriers (ISB)' in connection with mines? What barriers are used for limiting voltage and current respectively? (2 + 2)
b) What is a 'TEFC' enclosure for a motor? Why is it necessary? (2 + 1)
c) A 110 V, 1 kW, 1200 rpm separately excited dc motor is being driven by a single phase controlled rectifier supplied from 220 V, single phase mains. What is the speed at half the rated torque and a firing angle of 75°? (Armature resistance of motor is 0.4 Ω) (4)
4. a) What are the different methods of speed control of a three-phase induction motor? Which of these are applicable to squirrel-cage motors only? (3 + 1)
b) Draw the torque-speed characteristic of a three-phase squirrel-cage induction motor under stator voltage control. What is the major drawback of this method? Which type of load is suitable for this method? (2 + 2 + 1)
c) 'The induction motor operates in the constant torque zone under VVVF control'. Justify. (2)
5. a) The speed of a single phase induction motor is to be controlled by controlling its stator voltage. Suggest a small power electronic circuit to do so. Draw the stator voltage waveform. For your circuit, derive an expression for the rms value of the output voltage. (2 + 2 + 3)
b) What is static rotor resistance control of SRIM? (2)
c) Can Ward-Leonard control be applied to induction motors? Justify your answer. (2)

SECOND HALF

6. a) Compare the weights of copper required in a overhead transmission scheme using:
- (i) Constant direct current system
 - (ii) Single phase system
 - (iii) 3-phase 3-wire system.
- (Assume same transmitted power and peak voltage between conductors, same percentage loss in each case, unity power factor and balanced load).
- b) Describe different systems of distribution and mention their relative advantages. What is the difference between a feeder and a distributor? [6 + (3 + 2)]
7. a) What are the disadvantages of low power factor? Name the different methods of improving power factor of a system.
- b) Prove the following statement :
“ The sine of the most economical angle between the current and voltage in a system is equal to the ratio of the yearly charge on the fixed capital cost of power factor improvement apparatus to the tariff charge per kVA of M.D.”
- c) Compare the merits of distribution with:
- (i) Earthed neutral
 - (ii) Isolated neutral.
- [(2 + 2) + 4 + 3]
8. a) Draw a neat single line diagram for a typical colliery power receiving and distribution system clearly showing (i) Electricity Board Primary Substation (ii) Colliery surface substation (iii) Under ground substation (iv) Important feeders.
- b) What are the functions of the following in the above system ?
- (i) Transformer
 - (ii) Circuit Breaker
- [9 + 2]
9. a) What are the functions of the following in a typical electrical protective system ?
- (i) Relay
 - (ii) Circuit Breaker
 - (iii) Current Transformer
- b) How is a circuit breaker(C.B.) specified? Explain the principle of operation of a Sulphur Hexa-fluoride (SF₆) C.B. and state its merits. [6 + (2 + 3)]
10. Explain the role of the following equipment in an electrical system and state their principles of operation :
- (i) Vacuum C.B.
 - (ii) H.R.C. Fuse
 - (iii) Earthing System
- [4 + 4 + 3]