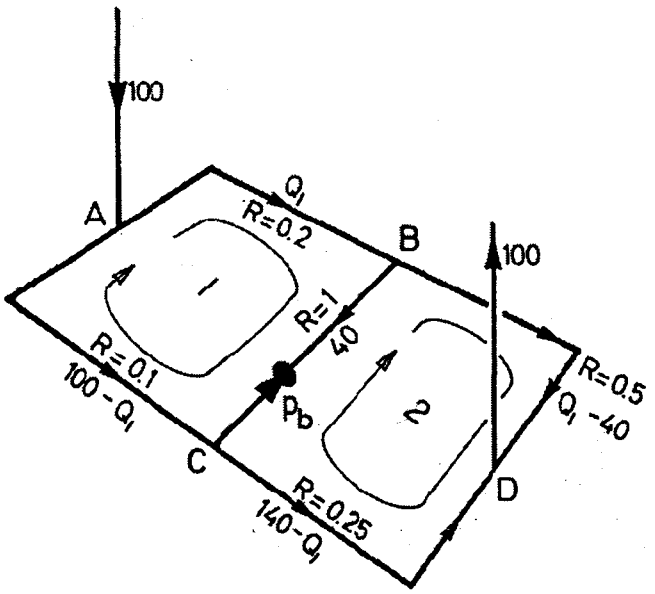
Odd-Semester Examinations – 2012-13
V SEMESTER B.E. (MINING ENGINEERING)
Subject: MN501 Mine Ventilation Engineering

Full Marks: 70 Time Allowed: 3 hours

An examinee can answer any five questions. However, in order to attempt questions for full marks, question no. 1 will have to be answered; otherwise the evaluation will be limited to total marks of 65 out of full marks of 70. Figures in the parentheses indicate marks. All parts of a question must be answered at one place.

1. A ventilation network is shown below. The symbols used have their usual significances. As may be seen, the mine is served by a downcast and an up-cast shaft, each passing 100 m^3 of air per second. The resistance of each subsurface branch is shown. A fan boosts the airflow in the central branch to 40 m^3/s. Determine the distribution of airflow and the total pressure, p_b developed by the booster fan. [18]



2. Keeping regulatory provisions in view explain the following in relation to underground mine ventilation:
   a. adequate ventilation
   b. gassy seams of the third degree
   c. general body of air
   d. ventilation plans
   e. ascensional ventilation [3+2+2+3+3=13]

3. a) A 2100 *mm* diameter exhaust fan (axial flow) is fitted with an evasee having an outlet to inlet ratio of 3.5:1. Calculate the pressure recovery in the evasee for a flow of 120 m^3s^{-1} through the fan taking the evasee efficiency at 70%.

   Also find the saving in electrical energy effected through the installation of the evasee assuming an overall fan and motor efficiency of 64%.
   What is the required fan static pressure if the mine has a resistance of 0.083 Ns^2m^{-8}

   b) A ventilation shaft of diameter 5.5 m passes an air-flow of 200 m^3/s at a mean density of 1.2 kg/m^3 and a mean temperature of 18°C (64.4°F). Determine the Reynolds

number for the shaft. Comment on the nature of airflow. (The expression for coefficient of dynamic viscosity of air is μ_{air} = (17.0 + 0.045 t) x 10^{-6}, Where t = temperature (°C) of air in the range 0 - 60°C) [9+4=13]

4. a) Calculate the pressure loss due to normal bend in a 300 m long airway of dimension 2.0 m width and 2.5 m height. The deflection due to the bend is 60° and radius of curvature of the bend is 3 m. If the airway has a friction co-efficient value of 0.008 kg/m^3, and an air quantity 9.5 m^3/s is passing through the air, calculate the total pressure drop.

   Explain any relationship equation you use. State clearly any other assumption made.

   b) A mine is ventilated by a fan producing 70 m^3/sec at 5 cm w-g. The fan is driven by a belt drive at a speed of 300 rpm. Electrical input to the motor under these conditions is 60 kW. The motor driving the fan is rated at 100 hp on motor shaft, motor efficiency being 90%. It is desired to increase the quantity of air flow by increasing the speed of the fan by changing the motor pulley. Calculate:
   (i) maximum speed at which the fan can be run without overloading the motor;
   (ii) volume of air that will flow at the new speed (neglect natural ventilating effect); and,
   (iii) w-g at the new speed; [6+7=13]

5. a) With the help of a neat sketch derive from first principle an expression to determine the theoretical head developed in a backward bladed centrifugal fan.

   b) Why a volute is used in a centrifugal fan to collect the air after it has left the periphery of an impeller? [11+2=13]

6. a) Explain the occurrence of natural ventilation in underground mines. An underground working has adopted descensional ventilation system while an otherwise similar underground working has an ascensional ventilation system. In which working the natural ventilating pressure (NVP) produced will be more? Justify your answer.

   b) Two connected shafts are 1200 m deep. The downcast shaft average temperature is 12.8°C, the upcast shaft air temperature is 26.7°C. Calculate the NVP in Nm^{-2} as well as in metres of motive column of air. Barometer reading at the shaft collar is 94.817 kPa. Neglect vapour pressure in the shafts. [(5+1+1)+6=13]

7. a) In a coalmine working a gassy seam of the second degree, the manager desires to install belowground a booster fan to enhance airflow through a ventilating district. What regulatory measures he is to take for installation and maintenance of the booster fan?

   b) Ventilation circuit of a mine consists of three splits, two being 1600 m long each and the third 800 m long. Resistances of the splits are proportional to their lengths. The short split is regulated so that each split receives 1500 m^3min^{-1} of air. The pressure loss due to friction in the main intake is 90 Pa and the pressure gauge across the three parallel splits is 140 Pa.

   If the regulator is removed, what quantity of air will circulate in each split? Assume fan-drift water-gauge remains unchanged and neglect the effect of natural ventilating pressure. [6+7=13]

8. a) State the criteria for selection of ventilation survey station. What is preferably the timing of ventilation survey and why?

   b) Explain with the help of sketches the moving traverse method of ventilation survey. [5+8=13]