SOLENT M202 NEWSLETTER No. 6 18th July 1973

Editor: (Mrs.) Marion Stubbs

LETTERS TO THE EDITOR

Many thanks for the M02 Newsletter. Sorry I haven't been in touch with you sooner. I've experienced the first big problem in my OU course so far, overtime at my work. So much so that I'm now a couple of weeks behind with study. I guess the only way is not to panic and just work steadily.

I have a solution to the first part of Geoff Yates' Problem Corner No. 3. Perhaps you could use it for your M202 Newsletter!! I can only add this piece of useless information: the area bounded by the tangent and the two given circles is called the Spandrel. Yours, Ron Davidson, M100 (Southampton)

(Editor: Delighted to hear from M100 in the Newsletter. Panic not, Ron - M202 call a couple of weeks timelag 'UP TO DATE')

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Thank you for the M202 Newsletter which I have enjoyed reading; you deserve an honorary ½-credit in Journalism. I am not likely to get to your meetings, some s.a.e's are enclosed.

I shall be happy to talk mathematics on the telephone; having had much more trouble with M202 than M201 last year I have been phoning for help quite frequently.

My interests in maths include computer programming, curve tracing and the maths and construction of ruled surfaces in perspex/nylon monofilament. If you hear of any likely customers for a 'thing' made on these lines, please let me know, - about £12 ready made or made to measure.

My wife and I enjoy doing the "Listener" crossword puzzles - they are always odd - there was a mathematical one recently concerning x, y, z less than 1000, $-x \in J7$, $y \in J11$, $z \in J13$, so was quite topical for M202. I hope my solution comes out of the hat for the £4 book token!

Are you planning to continue as an M251 Newsletter next year, or do you hope to broaden the range as we continue?

I am conditionally registered for M231 Analysis, with M251 as second choice. I have replied "possibly" to Kingsgate; I am doubtful about the value of summer schools, and think I shall be able to sort out most problems as I go along (as in M201 but not in M202.) Yours, Michael Gregory (Farnham).

(Editor: Thanks for your vote of confidence in the Newsletter. Since it is neither specifically M202 nor Solent, there is no reason for publication to cease, except for lack of cash and lack of student contributions. Other readers who wish it to continue can help to remedy both! If it is to continue in 1974, volunteers would be needed from each course, to distribute it at tutorials, please,)

<u>SOLUTION TO PROBLEM CORNER NO. 3</u> - Ronald Davidson, M100

(Given two circles and their common tangent, find the centre of the circle in the spandrel using straight edge and compasses only)

Considering the case in which the two circles are of equal diameter...

1. Join centres of circles, A, B.
2. Erect perpendiculars at A and B to cut circle of centre A at C and circle of centre B at D.
3. Join CD. CD is the common tangent.
4. Join the bisector of AB and CD - E and F respectively.
5. Join F and G to cut circle of centre B at H.
6. Join BH and produce it until it cuts EF at I. I is the centre of the circle in the spandrel. See diagram at end.

(Solutions are still required for the case of two unequal circles)

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<u>PROBLEM CORNER NO. 6</u>

<u>ONE CAKE</u> - <u>n CHILDREN</u>? - Martin Gardner (*Scientific American*)

There is a standard method by which two children can divide a cake so that each is satisfied that it has at least half: one cuts the cake and the other chooses. Devise a general procedure so that n children can cut a cake into n pieces so that each is satisfied that it has at least 1/nth of the cake.

<u>PILLOW PROBLEM No. 58</u> - Lewis Carroll (20 January 1884)

Three points are taken at random on an infinite plane. Find the chance of their being the vertices of an obtuse-angled triangle. (NB: Pillow problems are supposed to be done in your head - in bed!)

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<u>SOLUTIONS TO PROBLEM CORNER NO. 5</u>

A. 316 (Alan Nicol)

B. (Marion Stubbs) The inverse matrix is:

$$\begin{matrix} \frac{-1}{2x^2} & \frac{1}{2x} & \frac{1}{2x^2} \\ \frac{1}{2x} & \frac{-1}{2} & \frac{1}{2x} \\ \frac{1}{2x^2} & \frac{1}{2x} & \frac{-1}{2x^2} \end{matrix}$$

Constructions

Fig. 1.

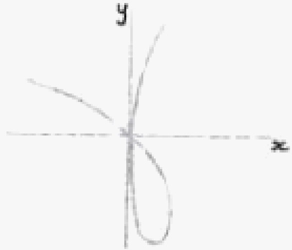

Fig. 2.

Fig 3a.

Fig.3b.

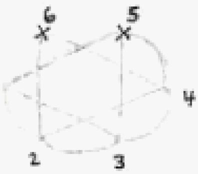

Fig. 4. n=6, x=2, q=3.
Circuit 1-3 4-6-2 3-5-1 2-4 5--1

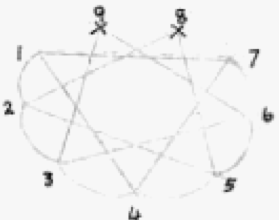

Fig.5. n=9, x=3, q=3.
Circuit: 1-4 5-8-2 3-6 7-1 2-5 6-9-3 4-7--1

<u>CONSTRUCTIONS</u> - Michael J. Gregory [See illustration above]

In 1966 my wife and I went to an exhibition of Naum Gabo's work at the Tate Gallery. Apart from a rotating painting in various shades of blue, the item which interested me most was "Linear Construction No. 2". This consisted of two sheets of perspex with notches all round and fitted together at right angles. It was about 3ft across and hung from the ceiling (fig. 1). A nylon monofilament was passed round and round (one circuit 1-2-3-4-5 is shown) so that interwoven ruled surfaces were formed. I was fascinated.

Assuming algebraic equations ($z = f(x)$, $y = g(x)$) I tried to find an equation for the three-dimensional curve formed by the intersections of the ruled surfaces (i.e. formed by moving a straight line) in one sector. I used up a lot of paper, discovered quite a lot of 3-D co-ordinate geometry and calculus. This led me to look at Cayley's ruled cubic:

$$x^2 + xyz - y^3 = 0 \qquad (1)$$

which has an interesting section a t z =1 (fig. 2).

The "ruled" character can be seen by rearranging equation (1) giving

$$xyz - y^3 = -x$$

therefore

$$y(xz - y^2) = -x^2$$

Introducing a parameter k we obtain

$$y = -kx \quad \text{and} \quad xz - y^2 = \frac{x}{k}$$

Each value of k specifies one position of the generating straight line. I found W.L. Edge's "The theory of ruled surfaces" difficult, but I think the experience of Nering and Herstein may make another attempt worth while.

I reverted to more practical lines of attack, and made a model of Gabo's construction, about 1/4 of the original size. The main problem was controlling 60 yards of nylon monofilament in a fairly small flat.

My more recent constructions have been original and made from a single sheet of perspex cut in an interesting shape, with holes (200 - 400, 1/32" or 3/64") drilled round the perimeter, with considerable loss of drill bits. The next job is to bend the perspex into an interesting shape in the oven. Oven gloves are.essential, and advice from our two young children adds interest to the process. One has to avoid any sharp bends which are liable to cause cracks on cooling. After cutting a sufficient length of monofilament to complete the construction, and sometimes dyeing the thread, the tedious job of threading begins. To save time in future, I plan to use slots rather than holes where there is no chance of the thread slipping out. At first I wondered whether the construction would collapse or the thread break, but after 4-5 years they are still in good order.

When threading, I decide on a step length x, which is constant for the construction. For a hole p, (holes are numbered consecutively) two possible types of threading are illustrated (fig. 3a and 3b). With (a) each hole has two threads;

(b) works well when there is a twisted portion of perspex.

The (p + x) hole has only one thread through it. If n is the total number of holes, x the step length as above, and q the number of holes connected as in (b) then I number the holes so that

1 to (n–q) are as in (a)
(n–q+1) is special) shown as X's
(n–q+2) to n are as in (b)) in figs. 4 & 5

Two examples of "acceptable" circuits are illustrated in figs. 4 and 5. To make a complete circuit some compromise for the last lap may be necessary.

For a particular value of n, I have developed a fairly efficient tabular method for finding some acceptable values of x and q. This does not give all the solutions, nor tell you whether there is an acceptable circuit for particular values n, x, q. One can do the latter by listing the complete circuit, a lengthy process for n greater than 100. It is not difficult to devise the algorithm for calculating successive positions of the thread for any n, x, q, but I have not been able to express this functionally or as a sequence. Without going into details, the problems are:

1. deciding whether the (n–q+1)hole is used twice before the circuit is complete and
2. in cases such as fig. 5 you do not reach a (b)-type hole at regular intervals.

H.M. Cundy and A.P. Rollett: "Mathematical models" describes the construction of some ruled surfaces, and others can be seen in the Science Museum.

Your comments will be welcomed.

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<u>VOCATIONAL COUNSELLING</u>

George_Watts has distributed a form about vocational counselling among 50 mathematics students in the Southampton area. If anyone else has any thoughts on vocational guidance for mathematics students, please write to George.

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<u>TEACHING IN HAMPSHIRE</u>

Liz Smith (A202) is campaigning against the proposed reduction of the numbers of teachers in the Hampshire area, and would welcome supporters. Letters from 10 Downing Street have been landing on her doorstep, and she is now seeking contact particularly with parents - not restricted to OU students, of course. If concerned about your children in large classes, write to Mrs. Elizabeth Smith.

<u>VIEWS ON M202</u>

In Newsletter No. 5, (Counsellor) Peter Bailey asked for students' views on M202 in these pages. Here are the first of the replies. Further views are requested. Anonymous students can use pen names.

1. Frank Ashley

M202 is a course in mathematics based on the assumption that the average student has a comprehension of mathematics equivalent to that of a mathematical don. This is borne out by the frequent assumptions in the answers to the SAQs, to the effect that "it is obvious that" and "assume that". For the assumption, if one had reached the standard required to make this statement one wouldn't be taking this course in the first place.

2. Geoffrey Yates

As a mere student of M202 I can only have a worm's eye view, and have to rely on the course team (!) to set the standard. The course material is very interesting, and at last, at Unit 20, a unifying concept seems to be appearing, and I do feel fortunate to be able to do this course (although it would be nice if we could use a few British text books.) However, some of the units are quite difficult for a student in isolation - I would say that the material has been presented rather than taught. Some of the assignments are very difficult - the more so in those cases where the supplementary booklet seems to have been written by a different person to the one who wrote the unit. In fact, I would rate the difficulty of some of the assignments as equivalent to asking someone to prove Pythagoras' theorem geometrically without telling him the construction. (Easy if you've seen it, but if you haven't...)

Well, that's my worm's, eye view - but how about a man's eye view? How do you qualified mathematicians view M202? Is it a fair one-credit 2nd-level course? Are the assignments fair? What will the exam, questions be like? (I don't suppose you will answer that one!)

3. Marion Stubbs

The name of the M202 game must surely be proof of the incomprehensible using theorems and definitions mentioned en passant only in answers to SAQs or in problems in the textbooks not included in the set readings. Radio and TV programmes are liable to clarify matters well after the due date of an assignment. One would like to see units written more like 'lectures' instead of being mere commentaries on the textbooks.

My major criticisms, on analysis, do seem to be directed against the CAG system which is openly admitted to be designed to sort out the weak, the mediocre and the brilliant, hence is oriented solely towards results, rather than towards true education. M202 is not so much a course as a battlefield. However, one cannot advise any M100 or M201 student to miss it - it is quite an experience, and in some way one feels proud to be able to engage in the battle at all, when one had no mathematical background before 1971. The topics themselves are clearly important, interesting, and may even be enjoyable under less pressure.

WELCOME, NEW READERS

The readership of this Newsletter has now increased once again, and by enthusiastic (and entirely voluntary!) courtesy of Dr. Orman, will in future be distributed to any M100 students who attend tutorials in Poole and Southampton who wish to have a copy.

So, to our new readers, we extend a particular invitation to write along to the editor with ideas for a new title for the newsletter, and also to write fervently, madly and frequently on any topic whatsoever. Anything written is published, censorship of opinions being contrary to editorial policy. (However, please keep length reasonable.) There have been times during the year when the editor had to write the whole thing herself, and this makes life very hard. On the whole, one would prefer a glut of contributions to the usual silence of deep thought, which, by all accounts, is typical of all mathematicians, not specifically the OU variety.

We have established an excellent communications system, unrivalled in the OU, with lists of students' addresses and telephone numbers available to any mathematics student anywhere. In particular, M202 readership extends from Weymouth and Dorchester in the west to Parnham in the east. Self-Help by telephone has been dubbed M.O.U.T.H.S. by a (jealous ?) A302 student. So send along your details - you will then be able to contact and be contacted by fellow OU maths students. Need for this may not be entirely obvious at present, but in future years we will be desperately thin on the ground, as M202 is already, and Bletchley staff have indicated that tutorials may well be 100 miles away, e.g. in Oxford. It seems essential to establish inter-student communications while we have the chance.

FINAL NOTES

Apparently we now enter a state of Newsletter blackout until the next batch of tutorials in September. While waiting, please think up something - anything - which YOU can write, and do please just keep on writing. It is best if contributions can be sent as soon as they are written, so that pages can be typed as they are ready, instead of one mad rush near 'publication' date.

Jolly fun puzzles are requested from staff and students alike for Problem Corner, also solutions to those published.

The general keynote should be spontaneous communication between people isolated by geography but united by a common interest in mathematics. Don't make a meal of it - masterly prose is not expected - but dash something off in ten minutes flat.

Please note that the new editorial office telephone may not be connected by July 18th (!) but will be sometime. Meanwhile, a shiny new telephone cries out for calls in the editorial home, and the editorial bedtime is generally after midnight!

Finally, it is hoped that those students who are likely to be interested in the Kingsgate College course(s) for OU maths half-credit courses in 1974 have already posted their requests, but if anyone is still hanging on for any reason, Kingsgate timetables etc. will be finalised in September. We were indeed privileged to have been asked at all.

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