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**ST. JOSEPH’S COLLEGE (AUTONOMOUS), BANGALORE**

**III SEMESTER END SEMESTER EXAMINATION- OCTOBER 2021**

**GE 318 - PSA Special Course - PCM, PEM, PMC, MEC, EMS, CMS, BCA A, BCA B.**

**Time: 2 ½ hours Max marks: 70**

**INSTRUCTIONS:**

1. This question paper is meant for the students who opted for the Special Course

2. Please mention clearly on your answer script that you opted for the Special Course

3. This booklet contains 4 printed pages.

4. Stick to the suggested word limits.

5. You will be penalised for plagiarism/copying lines from the passage.

**I Read parts of Vannevar Bush’s introduction to *The Amateur Scientist* published by Scientific American:**

One definition of an amateur is that he is an individual who pursues a study for the fun of it. This is hardly the point. Most professional scientists get fun out of their efforts; in fact many of them get so much satisfaction and enjoyment out of their work that they devote only secondary attention to the subject of what they are paid for their efforts. Amateurs have no monopoly on enjoyment.

Another definition is that an amateur derives no income from his efforts. We hear that the great strides in science in England in the early days were made by amateurs. This is only partly true. Such scientists as Priestley, Cavendish and Boyle were men of means, who experimented and wrote on natural philosophy as a proper undertaking for a gentleman. Sterling, a Scottish clergyman, invented the first really successful engine using a fixed gas cycle, which was not improved upon much for a century, and he certainly derived no income from his efforts. Certainly, one of the prime attributes of the amateur is that he does his work without thought of personal gain. For the amateur scientist, necessity is not the mother of invention.

Unfortunately, it is also customary to regard the amateur as a chap who knows only a little about a subject and who dabbles, in contrast with the professional, who knows a great deal and who creates. Of course, there are many amateurs who do simple things crudely. After all, it is necessary to learn to walk before one can leap and run.

This leads me to write a word about science itself. There is a prevalent opinion today that all science is carried on by great groups in expensive laboratories, using particle accelerators, X-ray spectrometers, radio telescopes and other costly paraphernalia. There is also the feeling that all true research is conducted by men who have prepared for the task by long years of patient study. Also that one has to be a genius in order to create. Now there is truth to all of this, and it is due to the national recognition and support of great scientific efforts that we are making today's rapid scientific strides forward. But this is not all the truth by any means. It took genius to discover the phenomenon of transduction of genetic characteristics, one of the greatest scientific advances of the last decade, more important than taking a shot at the moon, too complex to be explained in this short note. But it did not take great apparatus at the expense of taxpayers. All it required was glassware, chemicals, colonies of bacteria — and genius. It did not take genius in the early days for radio amateurs, supposedly crowded out of all useful radio channels, to open up a whole new part of the spectrum. Nor does it take enormous organization and support to accomplish very useful things. The great rush into atomistics and nucleonics, into space exploration, into atomic energy, has left relatively neglected great areas of what was once classical physics and chemistry. The whole vast field of biology has no such pressure of public interest behind it, and in the maze of its byways are thousands of unsolved problems. Many of them require no more than careful, patient observation and the skill to fit results into the jigsaw puzzle of advancing biological science.

**I A Answer the questions that follow in about 150 words each: [3x10=30]**

1. What do you think is the assumption that lies behind the idea: “For the amateur scientist, necessity is not the mother of invention”? Do you agree with that assumption? Give reasons.
2. Based on the above reading, readings from class and discussion, do you think words like ‘genius ‘and ‘creativity’ can be used in the context of scientific discovery? Explain with reference to at least one invention/discovery you know of.
3. The above book was first published in 1960. If you were asked to write a revised version of the introduction in 2021-22, would you retain the line: “The whole vast field of biology has no such pressure of public interest behind it”? Substantiate your choice with reasons.

**II Carefully read the following:**

“I think back with much amusement to some of the things I did early in life. One evening a few years ago I spent many interesting hours with Orville Wright. We spent the whole time telling each other about things we had worked on which did not pan out, and he took me up to his attic and showed me models of all sorts of queer gadgets. I wonder how many mature scientists shudder a bit when they find students who have hunted up the old theses they presented for degrees.”- Vannevar Bush

In 2016, Princeton professor Johannes Houshofer published his “CV of failures” on Twitter. He posted:” Most of what I try fails but those failures are often invisible, while the successes are visible”.

**II A Answer one of the following questions in about 200 words: [1x15=15]**

4.Attempt to write your own CV/Resume of failures based on failed home experiments or failed lab experiments. Add a note describing in detail the goals and procedure of the experiment. Based on your personal experience, would you want to make your failures “visible”?

**OR**

5.Attempt to make a poster/brochure (you may include hand drawn illustrations) outlining the goals and procedure to carry out a home experiment- using materials that might already be easily accessible at home. Add a note explaining the course of action if the experiment fails on the first attempt.

**III** Read about **The Crackpot Index- John Baez**

John Baez's crackpot index is a funny way to rate the theories often talked about in "alternative science" TV shows or books, or in undisclosed recipient emails in our mailbox, coming from an individual that boasts his/her new and revolutionary method that will change science forever.

A simple method for rating potentially revolutionary contributions to physics:

A -5 point starting credit.

1 point for every statement that is widely agreed on to be false.

3 points for every statement that is logically inconsistent.

5 points for using a thought experiment that contradicts the results of a widely accepted real experiment.

10 points for pointing out that you have gone to school, as if this were evidence of sanity.

10 points for beginning the description of your theory by saying how long you have been working on it. (10 more for emphasizing that you worked on your own.)

10 points for mailing your theory to someone you don't know personally and asking them not to tell anyone else about it, for fear that your ideas will be stolen.

10 points for offering prize money to anyone who proves and/or finds any flaws in your theory.

10 points for each new term you invent and use without properly defining it.

10 points for arguing that a current well-established theory is "only a theory", as if this were somehow a point against it.

10 points for claiming that your work is on the cutting edge of a "paradigm shift".

20 points for suggesting that you deserve a Nobel prize.

20 points for every use of science fiction works or myths as if they were fact.

20 points for naming something after yourself. (E.g., talking about the "The Evans Field Equation" when your name happens to be Evans.)

30 points for claiming that your theories were developed by an extra-terrestrial civilization (without good evidence).

40 points for claiming that the "scientific establishment" is engaged in a "conspiracy" to prevent your work from gaining its well-deserved fame, or suchlike.

**III A Answer the questions that follow in 5-8 sentences: [2x5=10]**

1. Is there any criterion for which you’d like to increase/decrease the points assigned? If yes, give details for the change. If not, explain why the above system of point allocation works according to you.
2. Do you think the above rating system could accidentally eliminate “good” science? Give one example or state at least one reason.

**III B Answer one of the following questions in about 200 words: [1x15=15]**

1. You’ve spent this semester reading and discussing ideas like verifiability, falsifiability, paradigm shifts and puzzle solving as ways of differentiating science from pseudoscience. Would you consider the Crackpot Index as one among the ones listed above? Corroborate your opinion with comparisons, reasons and examples.

**OR**

1. Attempt to develop your own solution for the demarcation problem (differentiating Science from pseudoscience). Provide details such as a name you’d like to give to this idea, the criteria for demarcation, possible exceptions, test cases, examples and why you think it would work better than existing solutions.

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