

**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**UNIVERSITY VILLAGE, PLOT 91 CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESS WAY, JABI - ABUJA.**

**FACULTY OF SCIENCES**

**DEPARTMENT OF PURE AND APPLIED SCIENCES**

**JANUARY/FEBRUARY 2018 EXAMINATION**

**COURSE CODE: PHY 312**

**COURSE TITLE: MATHEMATICAL METHODS OF PHYSICS II**

**TIME: 2 HOURS**

**INSTRUCTION: Answer One and any other Three (3)questions.**

**QUESTION ONE**

1ai) The displacement $f(x)$ of a part of a machine is tabulated with the corresponding angular moment $x$ (in degrees) of the crack. Express $f(x)$ as a fourier series up to the third harmonic.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| X | 0 | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 | 330 |
| F(x) | 2.34 | 3.01 | 3.69 | 4.15 | 3.69 | 2.20 | 0.83 | 0.51 | 0.88 | 1.09 | 1.19 | 1.64 |

11 marks

1bi) Verify that $P\_{n}(x)$ satisfy the Legendre differential equation.14marks

**QUESTION TWO**

2a) From the prescription $P\_{n}(x)= \sum\_{m=0}^{m}(-1)^{m}\frac{(2n-2m)!}{2^{n}m!\left(n-m\right)!(n-2m)!}x^{n-2m}$ with $m=\frac{n}{2}$ or $\frac{n-1}{2}$ whichever is an integer, obtain the first four Legendre polynomials. 6marks

2b) Using the above prescription, show that $(1-2xh+h^{2})^{\frac{1}{2}}$ is a generating function for the $P\_{n}(x)$. Show that $P\_{n}\left(1\right)=1$. 9 marks

**QUESTION THREE**

3a) Using recurrence relation for J show that

* + 1. $J\_{2}^{,}\left(x\right)=\left(1-\frac{4}{x^{2}}\right)J\_{1}+ \frac{2}{x}J\_{0}$,
		2. $4J\_{n}^{,,}= J\_{n-2} - 2J\_{n} + J\_{n+2}$15 marks

**QUESTION FOUR**

4a) If $u= \sqrt{\frac{1}{1-xy+y^{2}}}$ show that $x\frac{∂u}{∂x}-y\frac{∂u}{∂y}= y^{2}u^{3}$ 7marks

4b) If $u= e^{xyz}$ find $\frac{∂^{3}u}{∂x∂y∂z}$ 8 marks

**QUESTION FIVE**

5a) Prove the relation $nP\_{n}\left(x\right)=\left(2n-1\right)xP\_{n-1}\left(x\right)-(n-1)P\_{n-2}(x)$ for the Legendre polynomials.

7marks

5b) Using this relation, obtain the polynomials. P4, P5 and P6. 8 marks