



NATIONAL OPEN UNIVERSITY OF NIGERIA
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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.

14 marks

QUESTION TWO

2a) From the prescription $P_n(x) = \sum_{m=0}^n (-1)^m \frac{(2n-2m)!}{2^n m! (n-m)! (n-2m)!} x^{n-2m}$ with $m = \frac{n}{2}$ or $\frac{n-1}{2}$ whichever is an integer, obtain the first four Legendre polynomials.

6 marks

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 $P_n(1) = 1$. 9 marks

QUESTION THREE

3a) Using recurrence relation for J show that

i. $J_2'(x) = \left(1 - \frac{4}{x^2}\right)J_1 + \frac{2}{x}J_0$,
ii. $4J_n'' = J_{n-2} - 2J_n + J_{n+2}$

15 marks

QUESTION FOUR

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

7 marks

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

8 marks

QUESTION FIVE

5a) Prove the relation $nP_n(x) = (2n - 1)xP_{n-1}(x) - (n - 1)P_{n-2}(x)$ for the Legendre polynomials.

7 marks

5b) Using this relation, obtain the polynomials. P_4 , P_5 and P_6 .

8 marks