

Math 3140: Homework 9

Due: Wednesday, November 7

A.

15.13. Suppose H is a cyclic normal subgroup of G . Show that any subgroup of H is also normal in G .

(2) A group G is *meta-abelian* if there exists an abelian normal subgroup $A \triangleleft G$ such that G/A is also abelian. Show that G is meta-abelian if and only if $(G')' = 1$ (the commutator subgroup of the commutator subgroup).

(3) Find the commutator subgroup of $U_n(\mathbb{F}_p)$ for p prime. For which n is $U_n(\mathbb{F}_p)$ meta-abelian?

(4) Find the commutator subgroup of B_n .

B.

16.4. Show that if $A \triangleleft G$ and $B \triangleleft H$, then $(A \times B) \triangleleft (G \times H)$ and

$$(G \times H)/(A \times B) \cong (G/A) \times (H/B).$$

16.11 Let $\varphi : G \rightarrow H$ be a surjective homomorphism with kernel K .

(a) For every subgroup $B \subseteq H$, show that the set

$$\varphi^{-1}(B) = \{g \in G \mid \varphi(g) \in B\}$$

is a subgroup of G that contains K .

(b) Show that there is a bijection between

$$\left\{ \begin{array}{l} \text{Subgroups } A \subseteq G \\ \text{such that } K \subseteq A \end{array} \right\} \longleftrightarrow \left\{ \text{Subgroups } B \subseteq H \right\}.$$