



**NATIONAL OPEN UNIVERSITY OF NIGERIA**  
**PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI – ABUJA**  
**FACULTY OF SCIENCES**  
**DEPARTMENT OF PURE AND APPLIED SCIENCES**  
**2020\_1 SEMESTER EXAMINATION**

**COURSE CODE:** PHY 303  
**COURSE TITLE:** SPECIAL RELATIVITY  
**CREDIT UNIT:** 2  
**TIME ALLOWED:** (2 HRS)  
**INSTRUCTION:** *Answer question 1 and any other three questions*

**QUESTION 1**

- (a) (i) What is theory of relativity? [2 marks]  
(ii) Differentiate special relativity from general relativity. [2 marks]  
(iii) Name two coordinate systems commonly used in Physics. [2marks]
- (b) A man in a boat moving at constant speed of 60km/h relative to the shore throws an object in the forward direction with a speed of 30km/h. What is the speed of the object as measured by an observer at rest at the shore? [3 marks]
- (c) Explain two viewpoints advanced to retain the ether concept. [2 marks]
- (d) What is the Significance of the Lorentz factor? [2marks]
- (e) What is the factor of contraction for an object in the direction of motion? [3 marks]
- (f) Name two applications of Lorentz-FitzGerald coordinate transformation. [2 marks]
- (g) An inertial system  $S$  two events happen at the same place with a time separation of 4 s. Calculate the spatial distance of the two events in an inertial system  $S'$ , in which the events appear with a time separation of 5s [7 marks]

**Total Marks for Q1 = 25 marks**

**QUESTION 2**

- (a) Write the Lorentz- Einstein relations. What do these relations indicate? [9 marks]  
(b) At non-relativistic velocities what happen to the Lorentz- Einstein relations? [6 marks]

**Total Marks for Q2 = 15 marks**

### **QUESTION 3**

- (a) Write the inverse Lorentz transformation equations [6 marks]
- (b) Write the Relationship between the Coordinates and the Differentials in Lorentz transformation questions [9 marks]

**Total Marks for Q3 = 15 marks**

### **QUESTION 4**

- (a) Determine the formula for the relativistic Doppler shift in case in which the waves are observed in a direction parallel to a source velocity  $v$ . [6 marks]
- (b) Explain the following terms
  - (i) Length contraction [3 marks]
  - (ii) Time dilation [3 marks]
  - (iii) Velocity Addition [3 marks]

**Total Marks for Q4 = 15 marks**

### **QUESTION 5**

- (a) Write the relativistic velocity transformation equations. [6 marks]
- (b) List three points that are peculiar to electromagnetic waves in regard to relativistic Doppler Effect [6 marks]
- (c) Write the formula for momentum of a particle in motion at relativistic velocity. [3marks]

**Total Marks for Q5 = 15 marks**