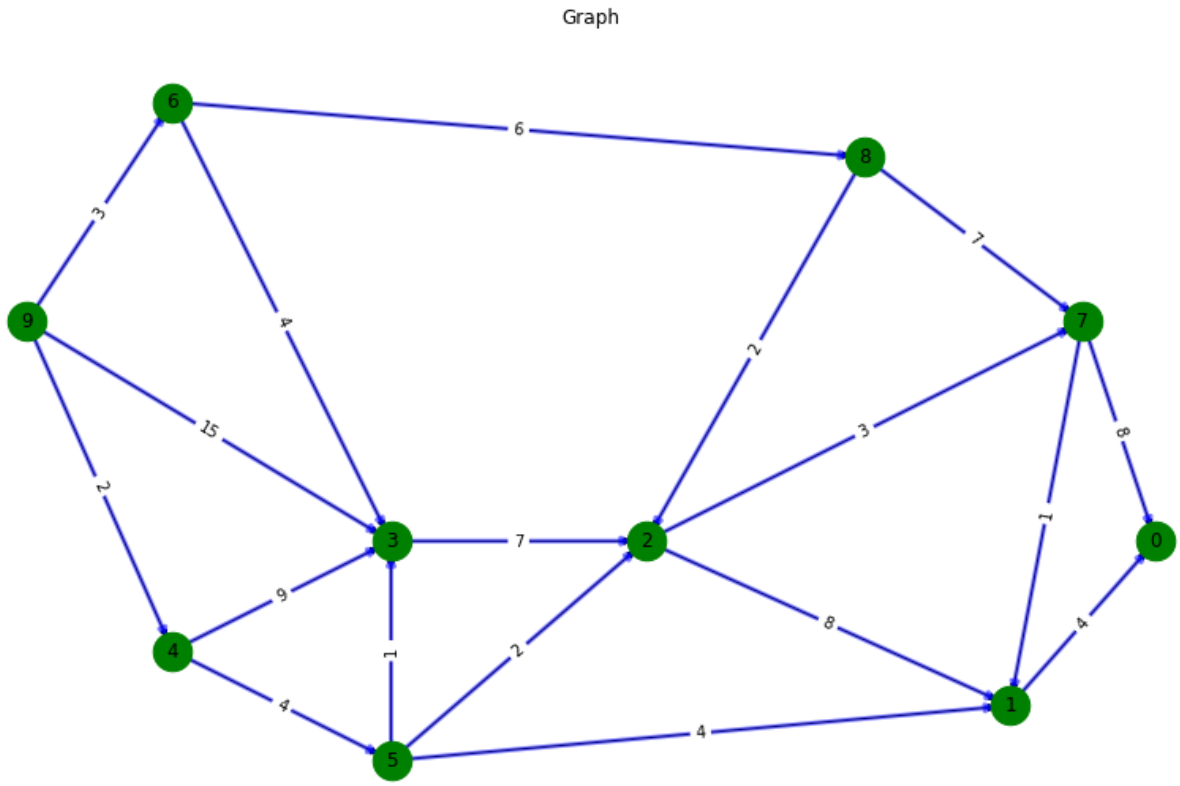
Programowanie sieciowe

In [3]:
```
import networkx as nx
import numpy as np
import matplotlib.pyplot as plt
```

Zadanie 1

Sciezka krytyczna

In [4]:
```
weights = [
    (1, 0, 4),
    (7, 0, 8),
    (7, 1, 1),
    (2, 1, 8),
    (2, 7, 3),
    (8, 2, 2),
    (5, 2, 2),
    (3, 2, 7),
    (4, 3, 9),
    (5, 1, 4),
    (5, 3, 1),
    (4, 5, 4),
    (6, 8, 6),
    (6, 3, 4),
    (8, 7, 7),
    (9, 6, 3),
    (9, 4, 2),
    (9, 3, 15)
]

G = nx.DiGraph()

G.add_weighted_edges_from(weights)

fig = plt.figure(figsize=(12, 7))

pos = {
    0: (17, 3.5),
    1: (15, 2),
    2: (10, 3.5),
    3: (6.5, 3.5),
    4: (3.5, 2.5),
    5: (6.5, 1.5),
    6: (3.5, 7.5),
    7: (16, 5.5),
    8: (13, 7),
    9: (1.5, 5.5)
}

nx.draw(G, pos=pos, with_labels=True)
nx.draw_networkx_edges(G, pos, width=3,alpha=0.5,edge_color='b')
nx.draw_networkx_nodes(G, pos,node_size=600, node_color="g")
labels = nx.get_edge_attributes(G,'weight')
nx.draw_networkx_edge_labels(G,pos,edge_labels=labels)
plt.title("Graph")
plt.show()
# print(nx.get_edge_attributes(G,'weight'))
```



9 - wierzcholek do ktorego nie wchodzi zaden inny

0 - wierzcholek z ktorego nie wychodzi zaden inny

In [5]:
```python
M = nx.to_numpy_array(G, nodelist=range(10))

def changeIndexing(M):
    M_copy = M.copy()
    M_copy[M_copy > 0] = 1 # Tworze macierz binarna
    columns = [i for i in range(len(M))] # Miejsce zapisu
    path = []

    while len(M) > 1:
        n = len(M)

        for i in range(n):
            if False not in list(M[:,i] == 0):
                mask = [k for k in range(n) if k != i]
                M = M[np.ix_(mask, mask)]
                path.append(columns.pop(i))
                break

    path.append(0)
    changedIndexes = [0 for _ in range(len(path))]

    for i, el in enumerate(path):
        changedIndexes[el] = i
    return changedIndexes
```

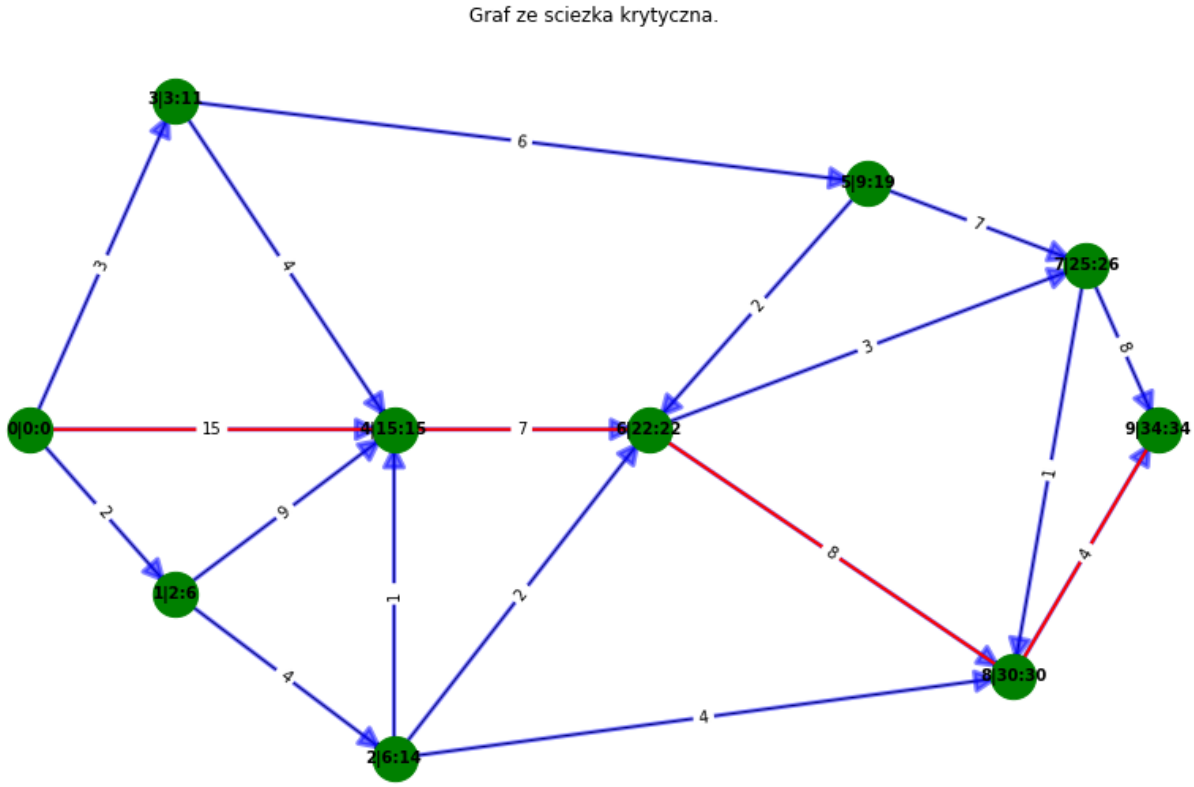
In [6]:
```python
class Queue:
    def __init__(self):
        self.queue = []

    def enqueue(self, val):
        self.queue.append(val)

    def dequeue(self):
```

```
        return self.queue.pop(0)

    def is_empty(self):
        return len(self.queue) == 0
```

In [7]:
```
def findCritical(M):
    n = len(M)
    newIndexes = changeIndexing(M)

    start = newIndexes[0]

    terminy = [[0, np.inf] for _ in range(n)]

    # Wykonac przeszukanie wszerz aby obliczyc najwczesniejsze terminy
    # Zapisac ostatni wierzcholek a nastepnie zrobic odwrotne przeszukanie wszerz aby ob
    queue = Queue()
    queue.enqueue(start)
    while not queue.is_empty():
        current = queue.dequeue()

        for i in range(n):
            if M[current][i] != 0:
                currentChangedIndex = newIndexes[current]
                changedIndex = newIndexes[i]

                if terminy[currentChangedIndex][0] + M[current][i] > terminy[changedInde
                    terminy[changedIndex][0] = terminy[currentChangedIndex][0] + M[curre
                queue.enqueue(i)

    end = 0
    terminy[newIndexes[end]][1] = terminy[newIndexes[end]][0]
    queue.enqueue(end)
    while not queue.is_empty():
        current = queue.dequeue()

        for i in range(n):
            if M[i][current] != 0:
                currentChangedIndex = newIndexes[current]
                changedIndex = newIndexes[i]

                if terminy[currentChangedIndex][1] - M[i][current] < terminy[changedInde
                    terminy[changedIndex][1] = terminy[currentChangedIndex][1] - M[i][cu
                queue.enqueue(i)

    indexes = {item: newIndexes[item] for item in newIndexes}
    critical_path_edges = []
    current = 0

    while current != 9:

        for i in range(n):
            if M[i][current] != 0 and abs(terminy[indexes[i]][0] - terminy[indexes[i]][1
                critical_path_edges.append((current, i))
                current = i

    return terminy, indexes, critical_path_edges
```

In [29]:
```
M = nx.to_numpy_array(G, nodelist=[i for i in range(10)])
terminy, old2NewIndexes, edges = findCritical(M)


fig = plt.figure(figsize=(12, 7))

pos = {
    0: (17, 3.5),
```

```
    1: (15, 2),
    2: (10, 3.5),
    3: (6.5, 3.5),
    4: (3.5, 2.5),
    5: (6.5, 1.5),
    6: (3.5, 5.5),
    7: (16, 4.5),
    8: (13, 5),
    9: (1.5, 3.5)
}

labels = {oldIndex: f"{newIndex}|{int(terminy[newIndex][0])}:{int(terminy[newIndex][1])}

nx.draw(G, pos=pos, labels=labels, with_labels=True, font_size=10, font_weight=1000)
nx.draw_networkx_edges(G, pos, width=3, alpha=0.5, edge_color='b', arrowsize=30)
nx.draw_networkx_nodes(G, pos, node_size=800, node_color="g")
nx.draw_networkx_edges(G, pos, edgelist=edges, width=2, alpha=1, edge_color='r', arrowsi
labels = nx.get_edge_attributes(G,'weight')
nx.draw_networkx_edge_labels(G,pos,edge_labels=labels)
plt.title("Graf ze sciezka krytyczna.")
plt.show()
```



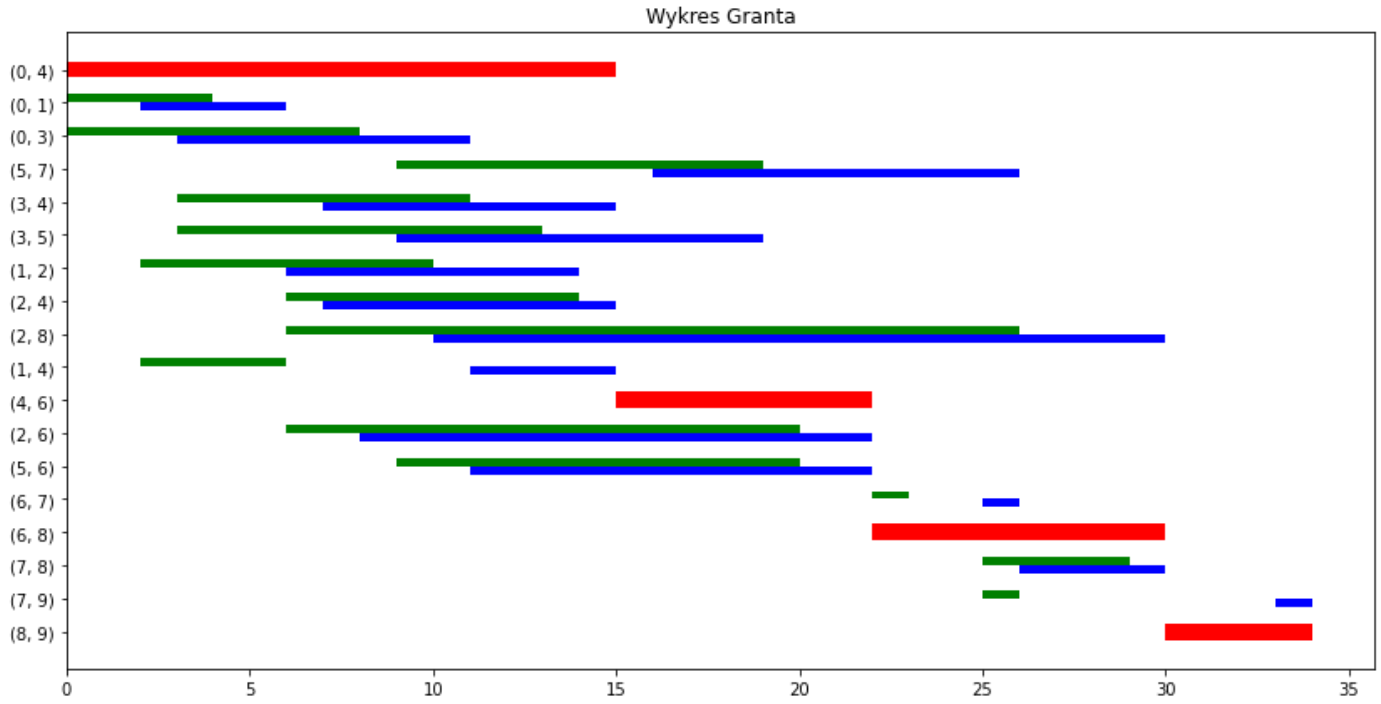
In [12]:

```
# Diagram Granta

def grant(edges, terminy):
    Pw = dict()
    Pp = dict()
    Kw = dict()
    Kp = dict()

    for edge in edges:
        Pw[(edge[0], edge[1])] = terminy[edge[0]][0]
        Pp[(edge[0], edge[1])] = terminy[edge[1]][1] - edge[2]
        Kw[(edge[0], edge[1])] = terminy[edge[0]][0] + edge[2]
        Kp[(edge[0], edge[1])] = terminy[edge[1]][1]
    return Pw, Pp, Kw, Kp
```

```
edges = [(old2NewIndexes[weight[0]], old2NewIndexes[weight[1]], weight[2]) for weight in
Pw, Pp, Kw, Kp = grant(edges, terminy)
```

In [34]:

```
edges_str = [f"({key[0]}, {key[1]})" for key in Pw.keys()]

Pw_list = list(Pw.values())
Pp_list = list(Pp.values())
Kw_list = list(Kw.values())
Kp_list = list(Kp.values())

# Critical
critical_bar_right = [kp if Pw_list[i] == Pp_list[i] else 0 for i, kp in enumerate(Kp_li
critical_bar_left = [pw if pw == Pp_list[i] else 0 for i, pw in enumerate(Pw_list)]

# Start
start_bar_right = [pp if Pw_list[i] != Pp_list[i] else 0 for i, pp in enumerate(Pp_list)
start_bar_left = [pw if pw != Pp_list[i] else 0 for i, pw in enumerate(Pw_list)]

# End
end_bar_right = [kp if Kw_list[i] != kp else 0 for i, kp in enumerate(Kp_list)]
end_bar_left = [kw if kw != Kp_list[i] else 0 for i, kw in enumerate(Kw_list)]


plt.figure(figsize=(14, 7))
plt.title("Wykres Granta")
plt.barh(edges_str, critical_bar_right, height=0.5, color='red')
plt.barh(edges_str, critical_bar_left, height=0.5, color='white')


plt.barh(edges_str, start_bar_right, height=0.25, color='green', align='edge')
plt.barh(edges_str, start_bar_left, height=0.25, color='white', align='edge')

plt.barh(edges_str, end_bar_right, height=-0.25, color='blue', align='edge')
plt.barh(edges_str, end_bar_left, height=-0.25, color='white', align='edge')
plt.show()
```



Na wykresie Granta zapas to zakres w ktorym obszar niebieski (mozliwy czas zakonczenia czynnosci) oraz zielony (mozliwy czas rozpoczecia czynnosi) sie pokrywaja lub odleglosc miedzy tymi zakresami jezeli obszary sie nie pokrywaja. Jezeli zakresy sie pokrywaja na calej dlugosci to zapas jest rowny 0 co ozancza, ze czynnosc jest krytyczna.